Diesel Direct Fuel Injection System, Servicing - New Beetle, 1.9L 4-Cyl. ALH

GENERAL INFORMATION

The Diesel direct injection system Engine Control Module (ECM) is equipped with a Diagnostic Trouble Code (DTC) memory. Before starting repairs, adjustments and troubleshooting, check DTC memory to see if there are any stored DTCs and make sure that Function 03: Output Diagnostic Test Mode (DTM) has been performed.

NOTE: Some checking and adjustment procedures can cause DTCs to be stored in DTC memory. For this reason, always erase DTC memory after completing all checking and adjustment procedures to Set the Readiness code.

SAFETY PRECAUTIONS

To prevent injuries to persons and/or damage to the Diesel direct fuel injection and glow plug system, observe the following:

- Switch OFF the ignition before connecting or disconnecting Diesel fuel injection or glow plug system wiring or test cables.
- If the engine requires cranking at starter speed, without starting, e.g. when checking compression, disconnect the N109 Fuel cut-off valve harness connector from the Diesel injection pump.
- Obtain the radio Anti-theft code from the customer BEFORE disconnecting the Battery Ground strap.
- Always make sure that the ignition is switched OFF before disconnecting and connecting the battery. Otherwise, the Diesel direct injection system Engine Control Module could be damaged.

Safety precautions during Test drives

WARNING: Secure Scan Tool to rear seat and operate from this position using a second technician.

Always attach Test and measuring instruments to the rear seat and operate them using a second technician from this location.

If test and measuring instruments are operated from the front passenger's seat and the vehicle is involved in an accident, there is a possibility that the person sitting in this seat could receive serious injuries if the airbag is triggered.

RULES FOR CLEANLINESS

When working on the fuel supply/injection system, pay careful attention to the following "6 rules":

- Thoroughly clean all unions and the adjacent areas before disconnecting.

- Place removed parts on a clean surface and cover over but do NOT use fluffy cloths (lint contamination)!
- Carefully cover opened components or seal over, if the repair cannot be carried out immediately.
- Only install clean components: Only unpack replacement parts immediately prior to installation. Do not use parts that have been stored loose e.g. in tool boxes.
- When the system is open: Do not work with compressed air if it can be avoided. Do not move the vehicle unless absolutely necessary.
- Make sure that no Diesel fuel runs onto the coolant hoses. Clean contaminated hoses immediately. Always replace affected hoses.

DIESEL INJECTION SYSTEM, COMPONENT LOCATIONS OVERVIEW

Components A, B and C are not shown in **Fig. 1** .

NOTE: The following list refers to items in Fig. 1 .

A. Brake vacuum vent valve switch for cruise control/diesel fuel injection -F47- and Brake light switch -F63-
   - Together in one housing in footwell on brake pedal

B. Throttle Position (TP) Sensor -G79-
   - in footwell on throttle pedal. See **THROTTLE POSITION SENSOR, CHECKING** .
   - In case of malfunction it is displayed as Throttle Position sensor -G69-

C. Clutch vacuum vent valve switch -F36-
   - in footwell on throttle pedal

NOTE: The following list refers to items in Fig. 1 .

1. EGR Valve
2. Change-over valve for intake manifold flap -N239-
3. Needle Lift Sensor -G80-
4. EGR vacuum regulator solenoid valve -N18-
5. Diesel Direct Fuel Injection (DFI) Engine Control Module (ECM) -J248-
   - with Barometric Pressure (BARO) sensor -F96-
   - tighten nut for ground wire (located forward of ECM) to 9 +/- 1 Nm (80 +/- 9 in. lb)
6. Wastegate bypass regulator valve -N75-
7. Mass Air Flow (MAF) Sensor -G70-
8. Engine Coolant Temperature (ECT) Sensor -G62-
9. Engine speed (RPM) sensor -G28-
10. Harness connector
    - for Needle lift sensor -G80-
11. Harness connector

- for Engine Speed sensor- G28-
- for Cold Start injector -N108-

12. Harness connector
    - for Fuel temperature sensor -G81-
    - for Quantity adjuster -N146-
    - for Modulating piston displacement sensor -G149-
    - for Fuel shut-off valve -N109-
13. Cold start injector -N108-
14. Fuel shut-off valve -N109-
15. Injection pump Quantity adjuster -N146-
    - with Fuel temperature sensor
    - with Quantity adjuster -N146-
    - with Modulating piston displacement sensor -G149-
16. Manifold Absolute Pressure (MAP) sensor -G71- and Intake Air Temperature (IAT) sensor -G72-

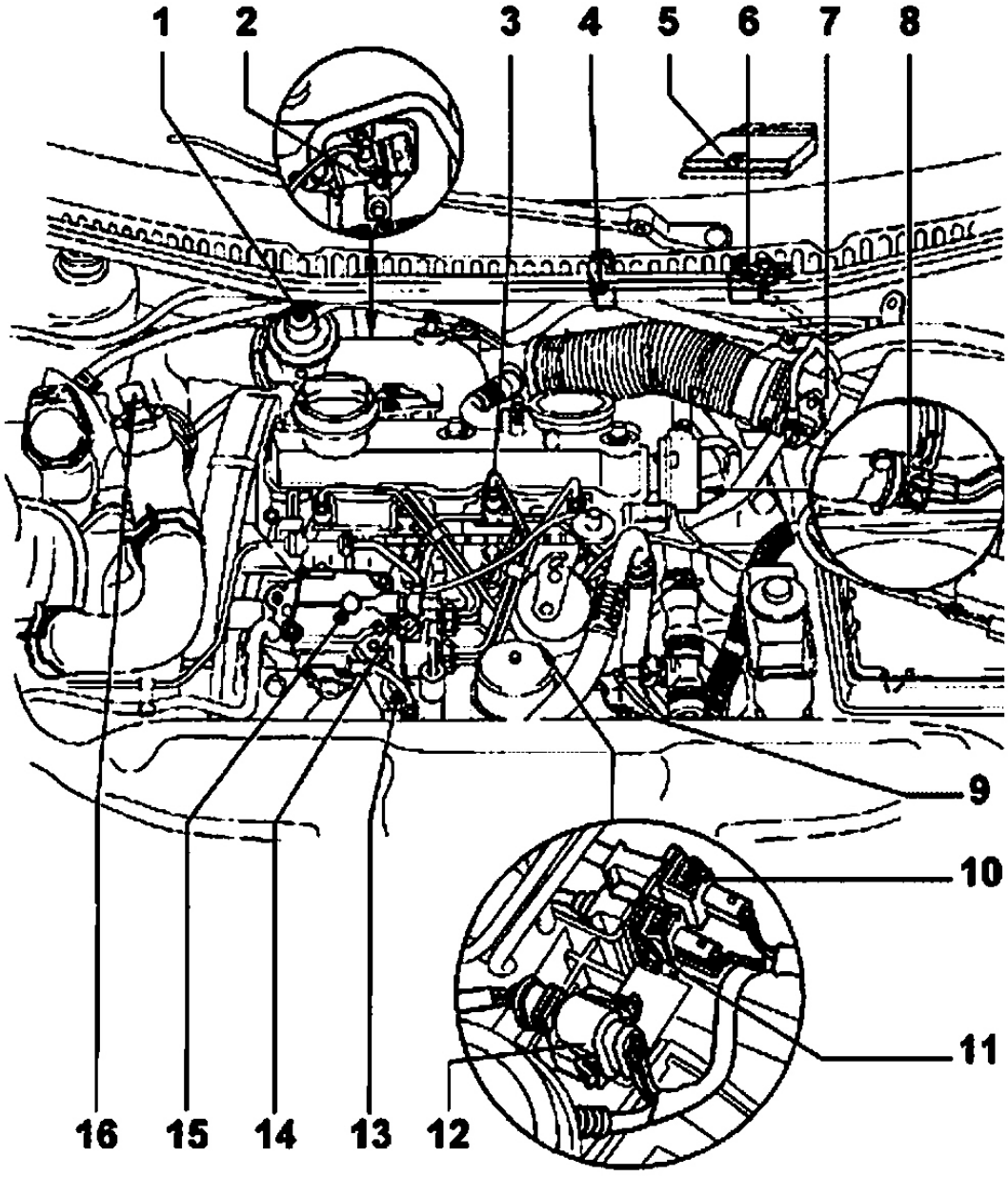

Fig. 1: Diesel Injection System Components
Courtesy of VOLKSWAGEN UNITED STATES, INC.

DIESEL INJECTION PUMP, SERVICING

NOTE: **The following list refers to items in Fig. 2 .**

1. 20 Nm (15 ft lb) + 1/4 turn (90°) further
    - Always replace
2. Injection pump sprocket
3. Nut

CAUTION: Do not loosen nut or basic setting of pump may change. This cannot be reset using normal workshop equipment.

4. Union
    - 25 Nm (18 ft lb)
    - for supply line
    - from fuel filter
5. Diesel injection pump
    - with Quantity adjuster (metering)
    - with Quantity adjuster -N146-
    - with Modulating piston displacement sensor -G149-
    - with Fuel temperature sensor
6. Fuel shut off valve
    - 40 Nm (30 ft lb)
7. Union
    - for return line
8. Return line
    - to control valve/fuel filter
9. 25 Nm (18 ft lb)
10. Fuel injector lines
    - 25 Nm (18 ft lb)
        - Remove with 3035
        - Always remove fuel line cluster as an assembly
        - Do not bend, kink or alter shape
11. Union
    - 45 Nm (33 ft lb)
    - with pressure valve
12. 25 Nm (18 ft lb)
13. 3rd cylinder Fuel injector
    - includes Needle lift sensor -G80-
    - Removing and installing, see **FUEL INJECTORS, REMOVING AND INSTALLING** .
    - Servicing, see **FUEL INJECTORS, SERVICING** .

14. 20 Nm (15 ft lb)
15. Retainer
16. Mounting
17. Heat shield
    - Always replace
18. 10 Nm (7 ft lb)
19. Cold Start injector -N108-, see OUTPUT DIAGNOSTIC TEST MODE (DTM) (FUNCTION 03).
20. Strainer
21. O-ring
    - Always replace
22. 25 Nm (18 ft lb)
23. Timing cover
    - Replace O-ring if leaking. See **DIESEL INJECTION PUMP TIMING COVER O-RING, REPLACING** .
24. Sleeve
    - with nut
25. Assembly bracket
    - Removing and installing. See **1.9L4-CYLINDER TDI ENGINE** .
26. 25 Nm (18 ft lb)

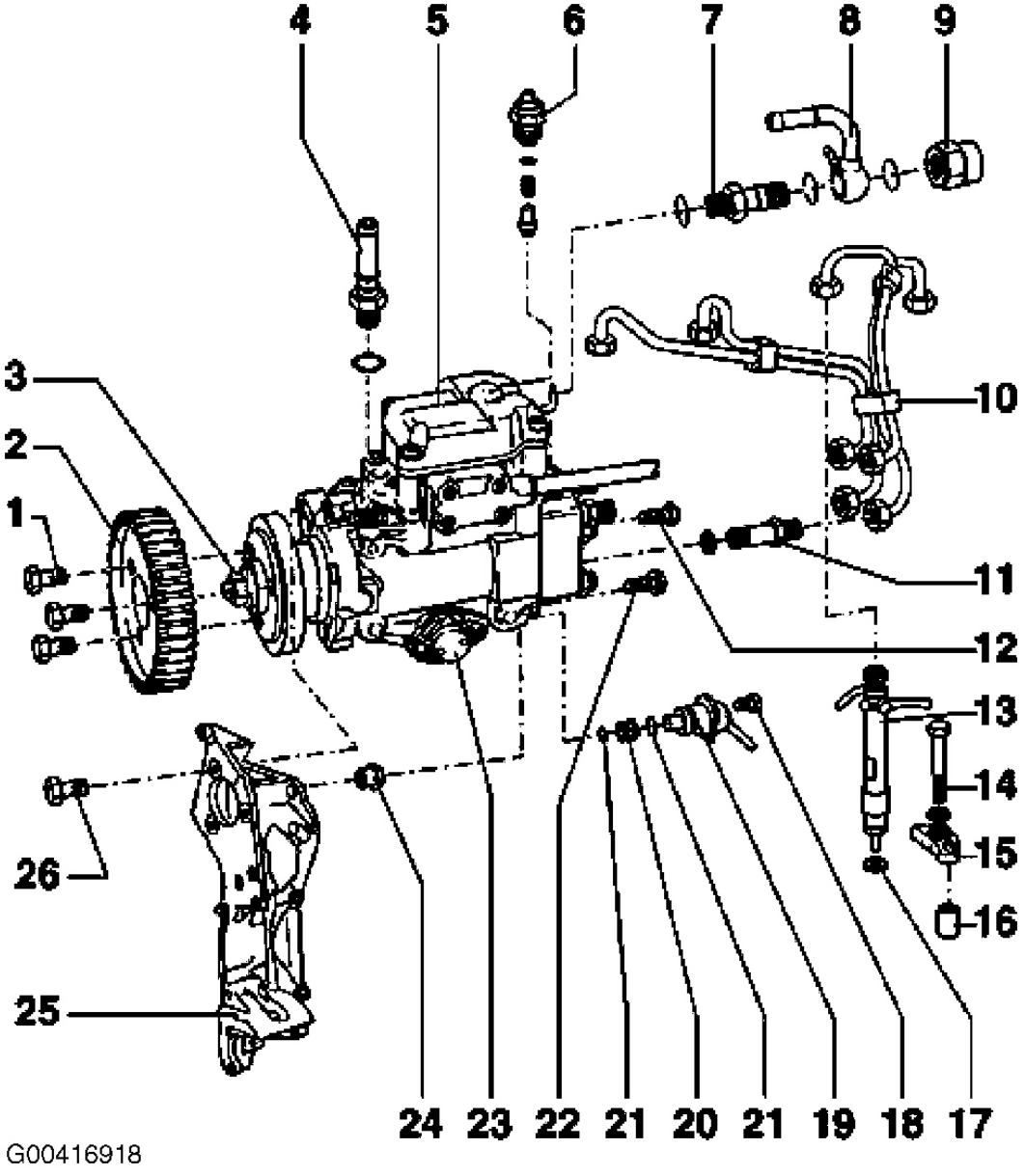

Fig. 2: Diesel Injection Pump Components
Courtesy of VOLKSWAGEN UNITED STATES, INC.

INTAKE MANIFOLD CHANGE-OVER VALVE, SERVICING

The intake manifold change-over flap is closed for approx. 3 seconds when engine stops and then opens again which reduces the stop jolt.

Intake manifold change-over valve.

NOTE: The following list refers to items in Fig. 3 .

1. Intake manifold
2. 10 Nm (7 ft lb)
3. O-ring
    - Always replace
4. Connecting flange
    - with EGR valve and change-over flap
5. 10 Nm (7 ft lb)
6. Gasket
    - Always replace
7. Connecting line
    - to exhaust manifold
8. 25 Nm (18 ft lb)
9. Vacuum control element
10. Intake Manifold Flap Change-over valve -N239-
    - Checking
11. Vacuum supply
    - from vacuum pump

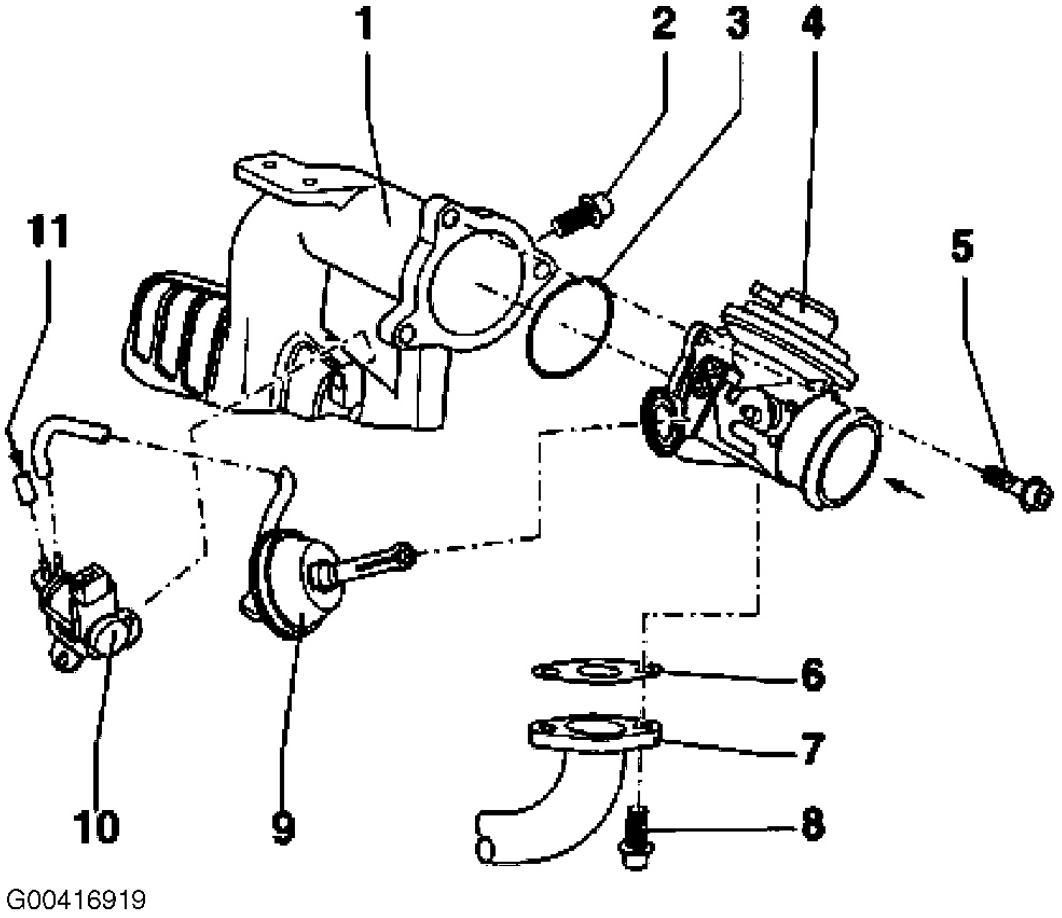

Fig. 3: Intake Manifold Change-Over Valve Components
Courtesy of VOLKSWAGEN UNITED STATES, INC.

DIESEL INJECTION PUMP, REMOVING AND INSTALLING

Special Tools

- 3098 Lever camber adjustment
- V159 Pin wrench
- 3359 Rig pin
- VAG1318/10 Adapter
- 3418 Adjustment guide
- VAG1390 Hand vacuum pump
- 2068A Adj. gauge TDC
- 3035 Injector line wrench

- VAG1331 Torque wrench 5 to 50 Nm (3.7 to 37 ft lb) or equivalent

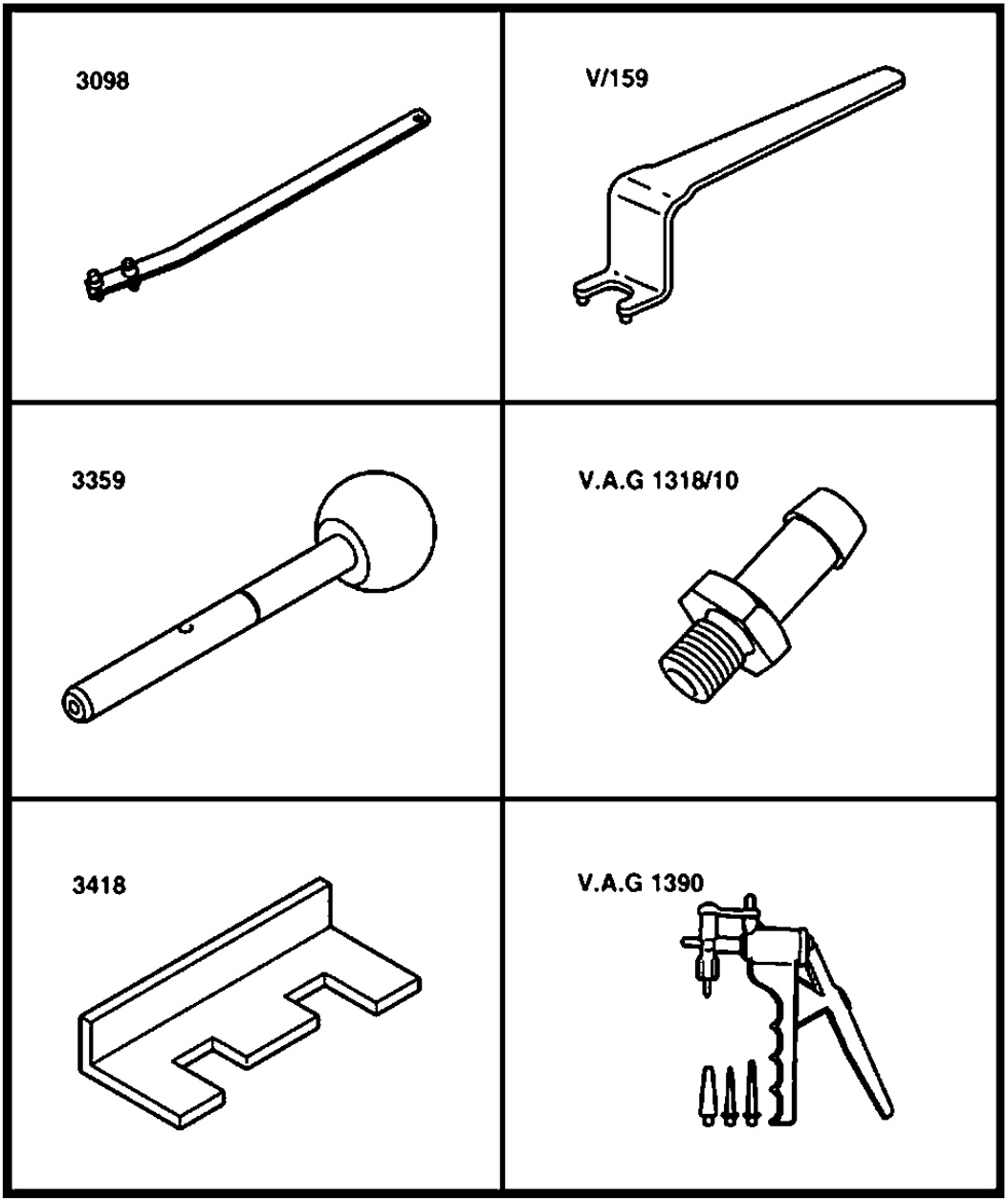

Fig. 4: Identifying Special Tools (1 Of 2)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

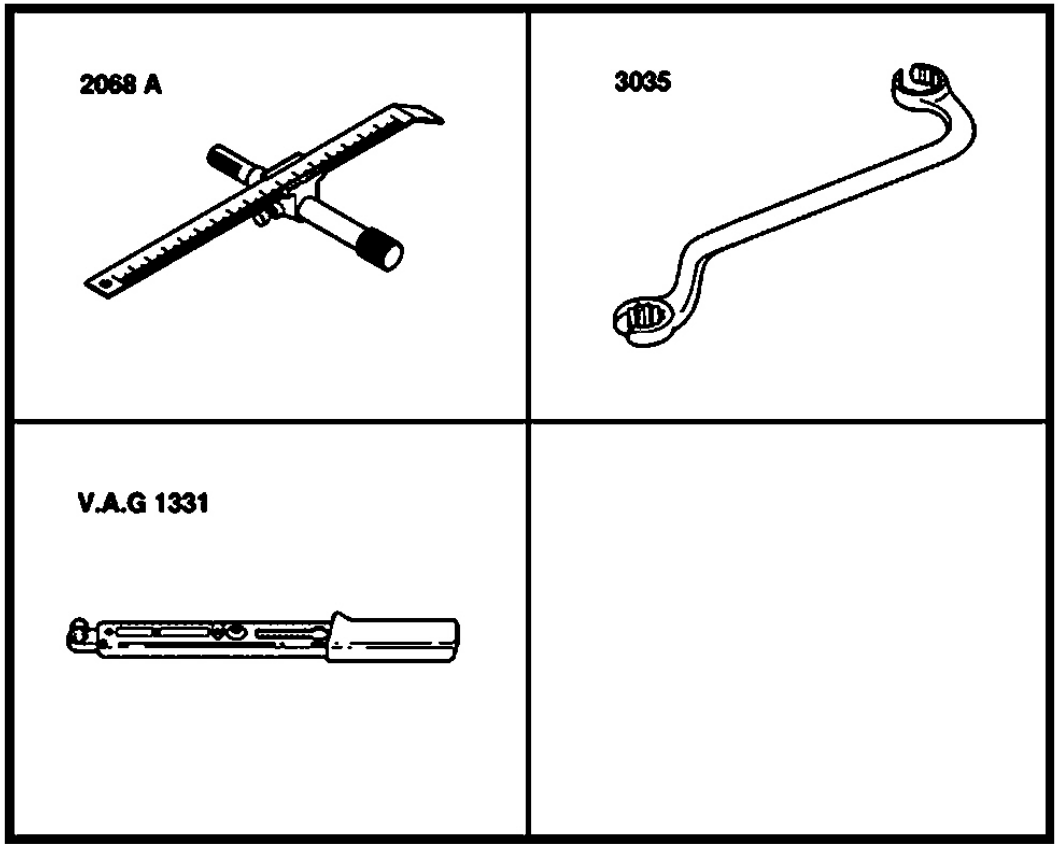

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Fig. 5: Identifying Special Tools (2 Of 2)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

DIESEL INJECTION PUMP, REMOVING

WARNING: Fire hazard! Do NOT have anything in the area that can ignite Diesel fuel.

- Unbolt all fuel lines at fuel pump.

NOTE: Use 3035 tubing wrench to loosen the high pressure fuel lines.

- Cover openings with a clean cloth.
- Remove connecting line between charge air cooler and intake manifold.
- Remove upper toothed belt guard and valve cover.
- Remove vacuum pump for brake servo.

- Turn crankshaft to cyl. 1 TDC (arrow).

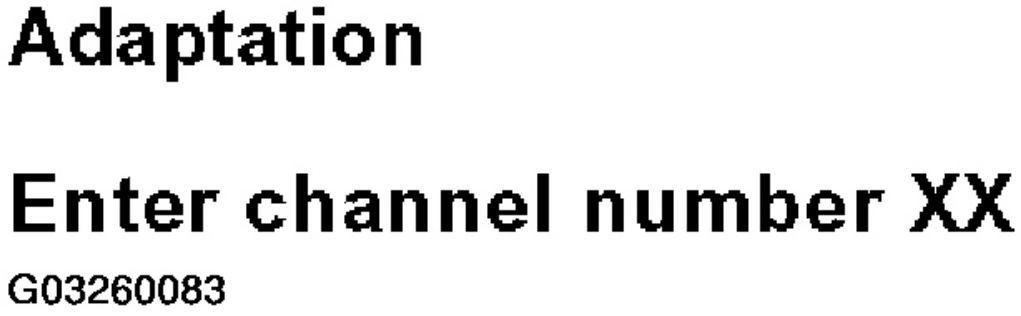

Fig. 6: Identifying Crankshaft At Cyl. 1 TDC (Manual Transmission)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Turn crankshaft to cyl. 1 TDC (arrow)
  - for automatic transmission

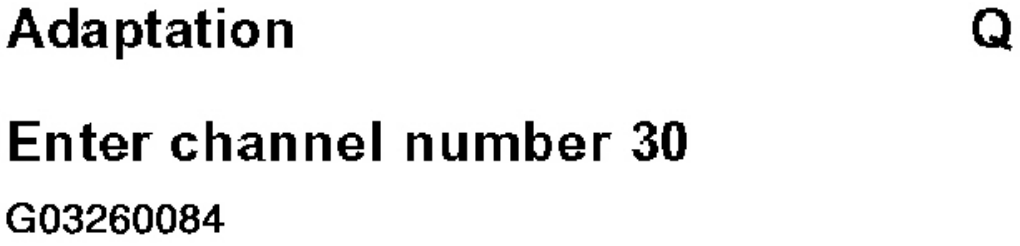

Fig. 7: Identifying Crankshaft At Cyl. 1 TDC (Automatic Transmission)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

With engine removed

Vehicles with manual transmission

- Install 2068 A TDC gauge as shown.
- Set adjustment device to 96 mm (arrow -A-).

- Left-hand notch of the vernier scale is the reference point.

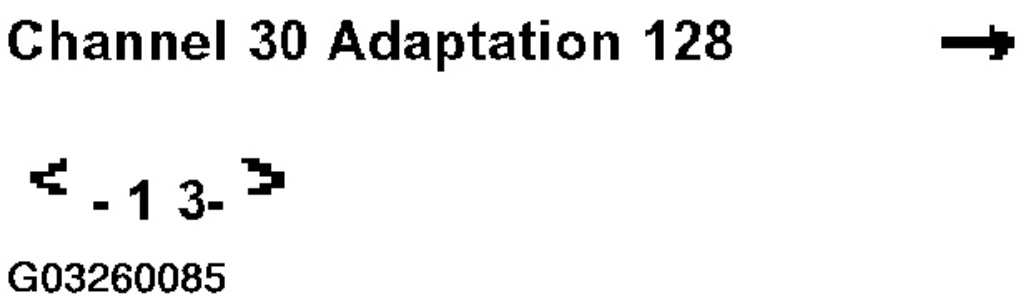

Fig. 8: Installing 2068 A TDC Gauge On Flywheel
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Turn crankshaft until flywheel TDC marking aligns with point of setting device (arrow -B-).

Vehicles with automatic transmission

- Install 2068 A TDC gauge as shown.
- Set adjustment device to 30 mm (arrow -A-).
  - Left-hand notch of the vernier scale is the reference point.

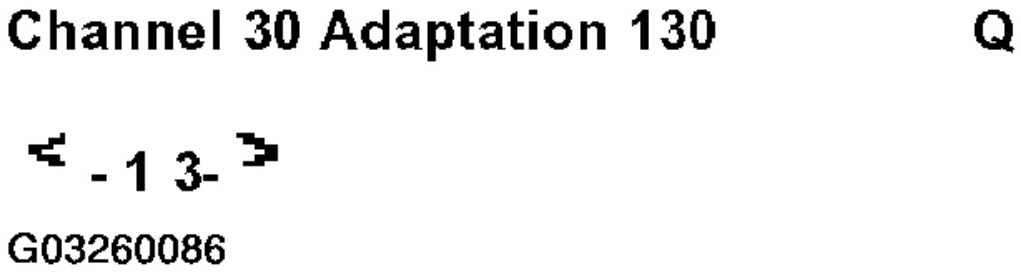

Fig. 9: Installing Adjustment Device On Flywheel
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Turn crankshaft until TDC marking on drive plate aligns with point of setting device (arrow -B-).

All vehicles

- Lock camshaft with setting bar.

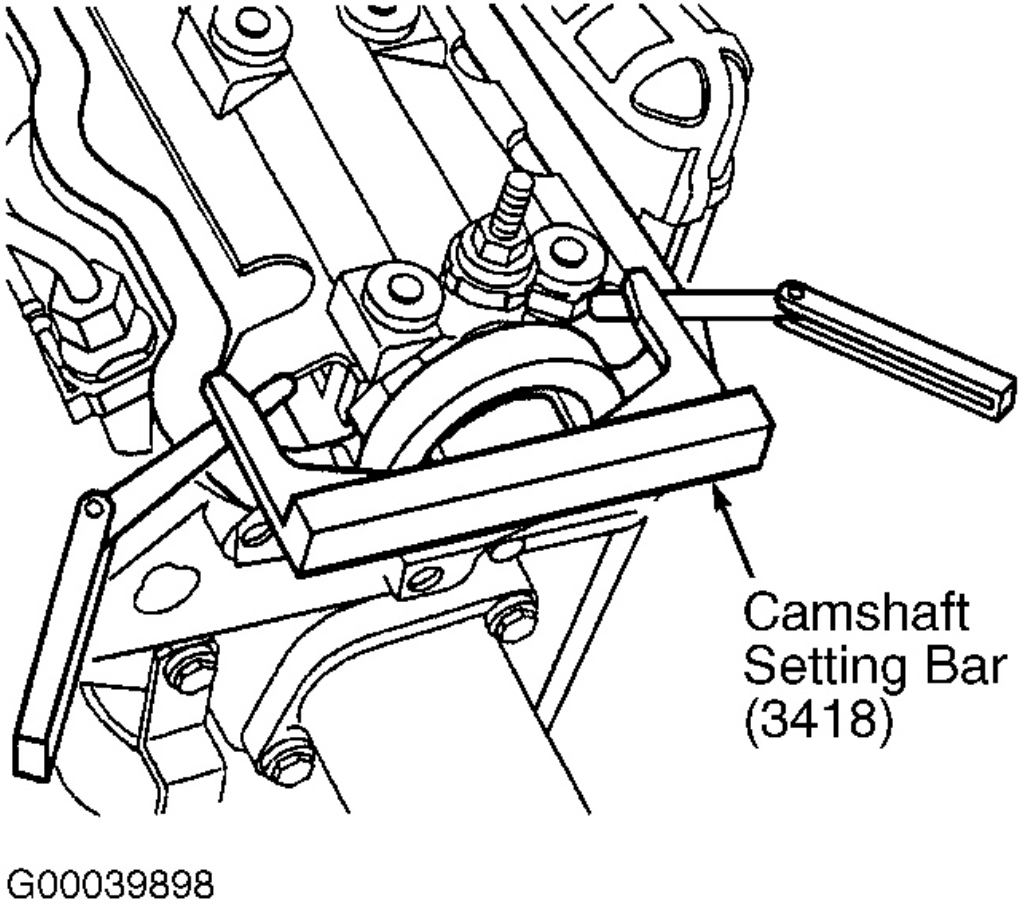

Fig. 10: Locking Camshaft With Setting Bar
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Centralize setting bar as follows:

  Turn camshaft so that one end of setting bar contacts the cylinder head. Using feeler gauge, establish the gap at the other end of the setting bar. Place a feeler gauge corresponding to half the gap between setting bar and cylinder head. Turn camshaft until the setting bar contacts the feeler gauge. Place a 2nd feeler gauge, of same thickness, at the other end between the setting bar and cylinder head.

- Remove injection pump sprocket mounting bolts -1-.

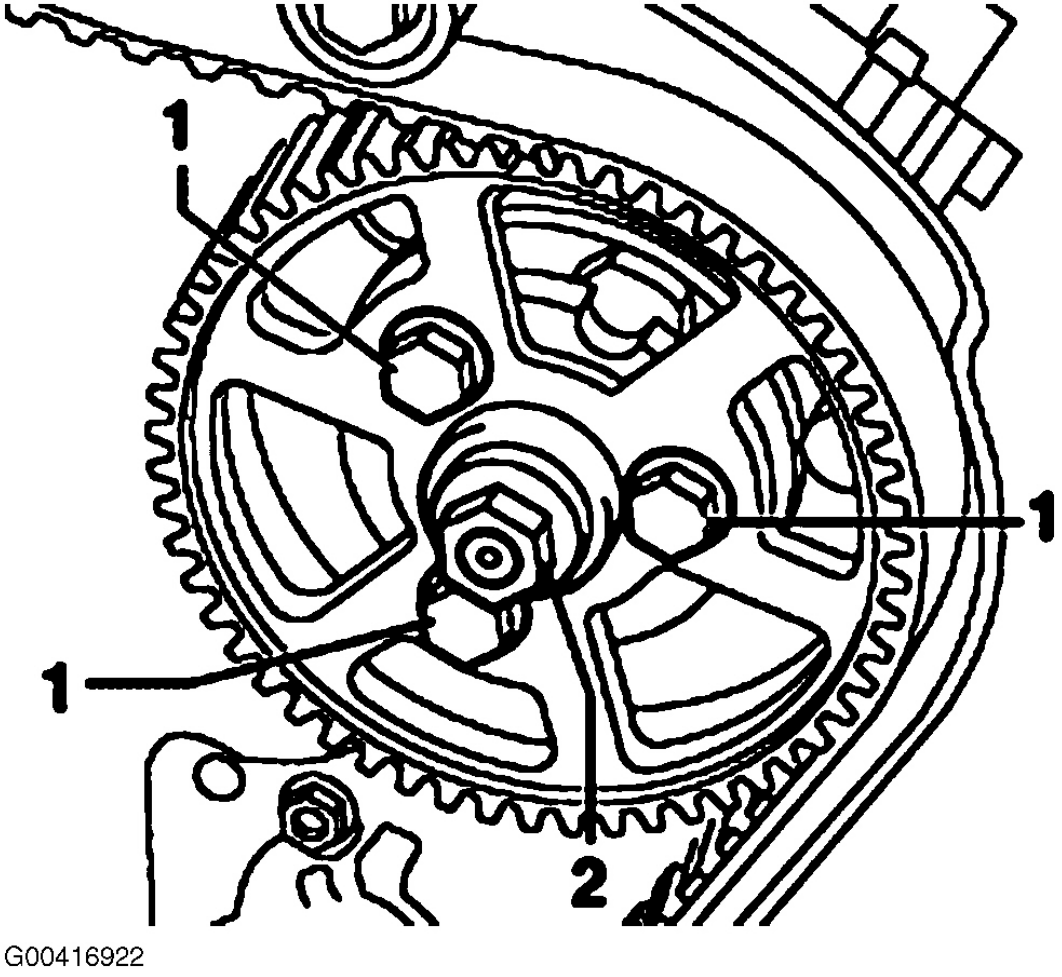

Fig. 11: Injection Pump Sprocket Mounting Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

CAUTION: Do not loosen hub nut -2- for ANY reason. Otherwise, the Diesel injection pump basic setting will be altered and cannot be reset with normal workshop equipment.

- Remove tensioning roller nut.
- Relieve tooth belt tension then remove camshaft and injection pump sprockets.
- Disconnect Quantity adjuster harness connector and unclip connector from retainer.
- Remove mounting bolts from assembly bracket -1-.

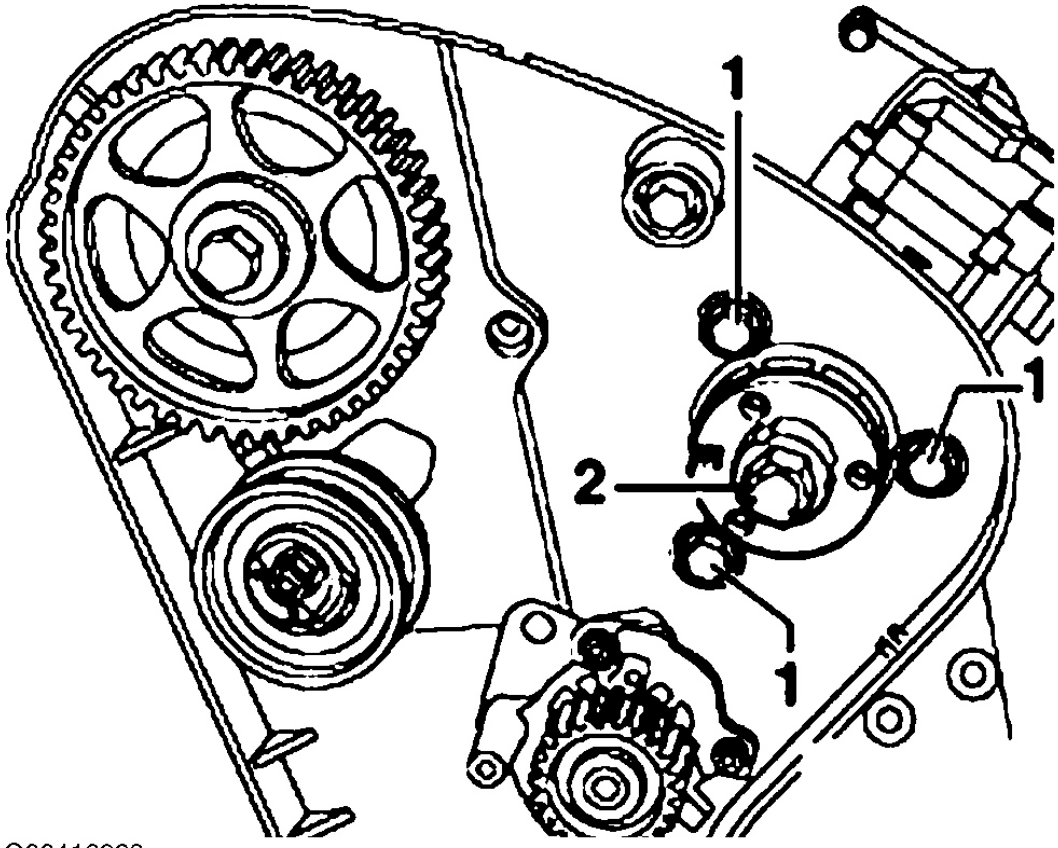

Fig. 12: Assembly Bracket Mounting Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove bolt from rear support (arrow).

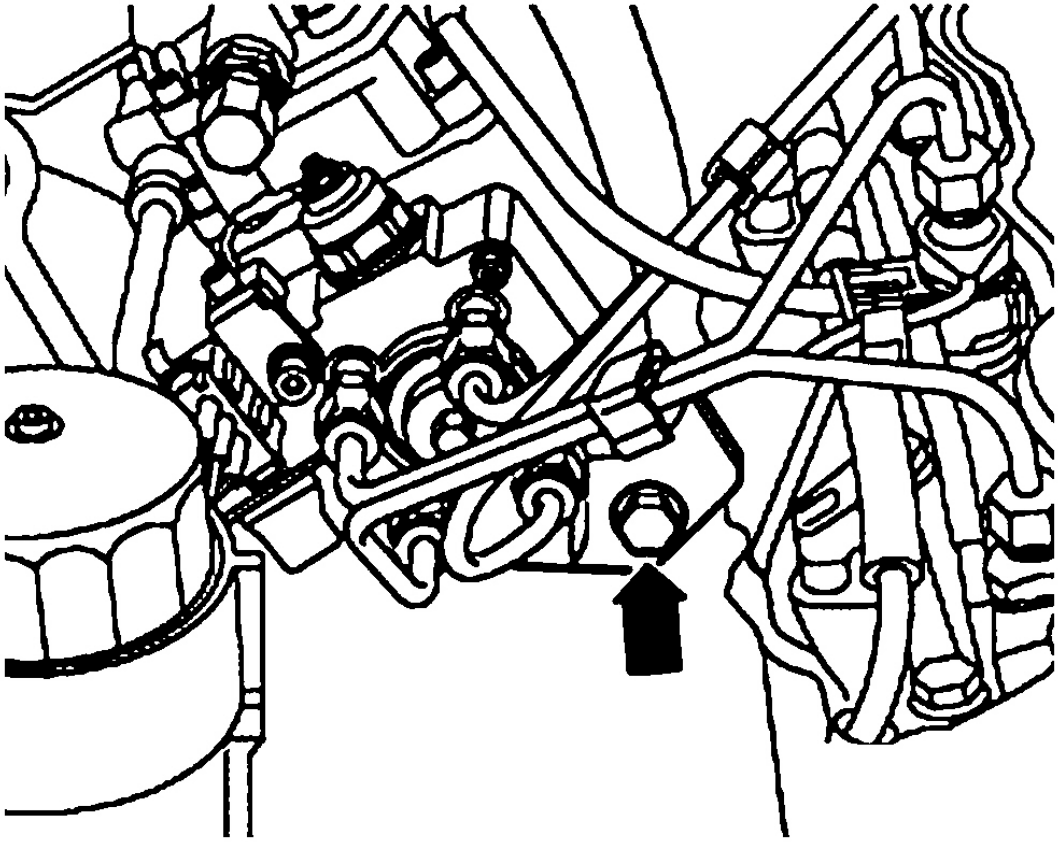

Fig. 13: Diesel Injection Pump Rear Support Bolt
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Remove Diesel injection pump.

DIESEL INJECTION PUMP, INSTALLING

- Insert injection pump into assembly bracket then tighten mounting bolt on rear support with conical nut first.
- Insert front mounting bolts.
  - tighten to 25 Nm (18 ft lb)
- Install new bolts (arrows) to mount injection pump sprocket to hub but do not tighten.

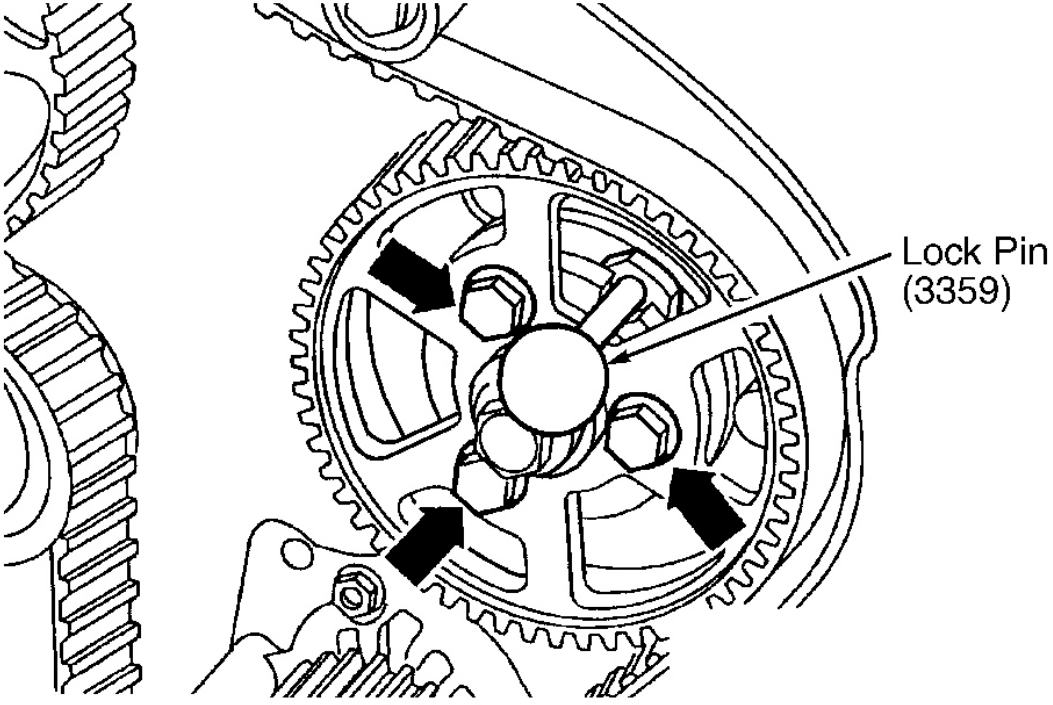

Fig. 14: Installing Injection Pump Bolts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Align injection pump sprocket to central position in elongated holes.
- Lock injection pump sprocket using 3359 pin.
- Loosen camshaft sprocket mounting bolt a half turn.
- Place a drift through hole in rear of toothed belt guard and release camshaft sprocket from camshaft taper with blow from hammer.

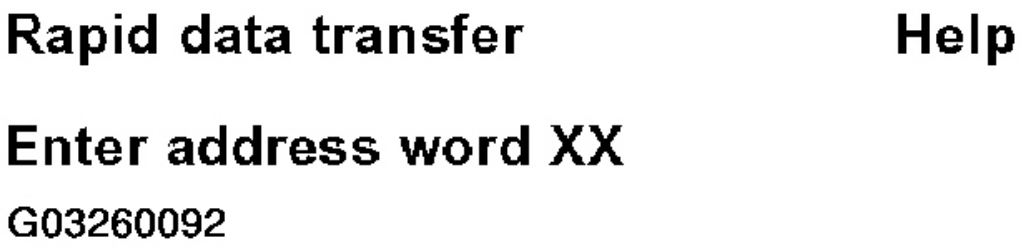

Fig. 15: Installing Drift Through Hole In Rear Of Toothed Belt Guard
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove camshaft sprocket.
- Check whether TDC mark on flywheel and reference mark are aligned.
- Place tooth belt on injection pump sprocket and tensioning roller.
- Install camshaft sprocket into toothed belt and secure sprocket such that the camshaft can still turn.
- Tension toothed belt using pin wrench (e.g. Matra V159) on eccentric and turning clockwise until notch and raised mark align (arrows).

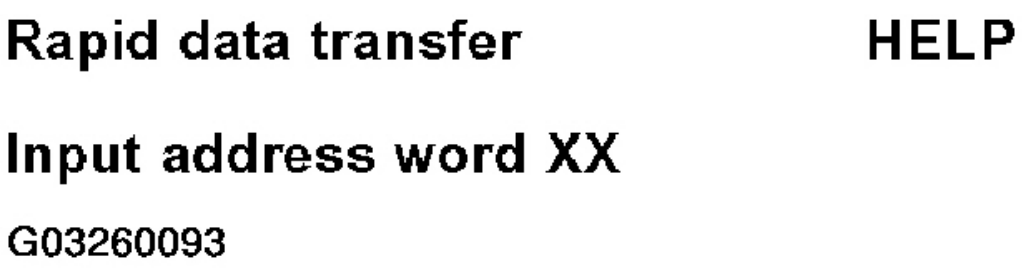

Fig. 16: Tightening Lock Nut On Tensioning Roller
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Make sure retaining hook is correctly seated in toothed belt guard.

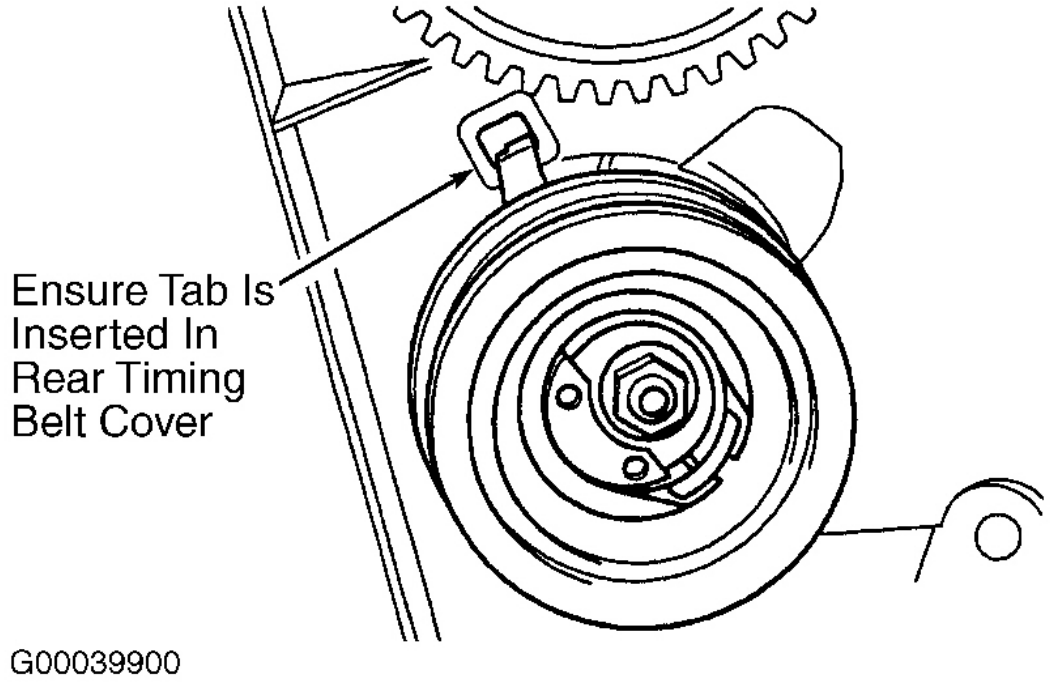

Fig. 17: Installing Timing Belt Tensioner Retaining Hook
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Tighten mounting nut.
  - 20 Nm (15 ft lb)
- Check TDC mark on flywheel again.
- Tighten new mounting bolts for injection pump sprocket.
  - 20 Nm (15 ft lb)

NOTE:

- **After dynamically checking the injection timing, tighten the bolts an additional 1/4 turn (90°).**
- **The mounting bolts (stretch design) may only be used once.**

- Tighten camshaft sprocket mounting bolt.
  - 45 Nm (33 ft lb)
- Remove 3359 locking pin.
- Remove 3418 setting bar from camshaft.
- Turn crankshaft two rotations in direction of engine rotation until crankshaft is set to cyl. 1 TDC again.
- Reconnect injection lines, fuel supply line and electrical wiring.

Fill injection pump with Diesel fuel as follows.

- Screw 1318/10 adapter into injection pump return/supply opening.
- Connect VAG1390 hand vacuum pump to adapter using approx. 40 inches of transparent plastic hose.

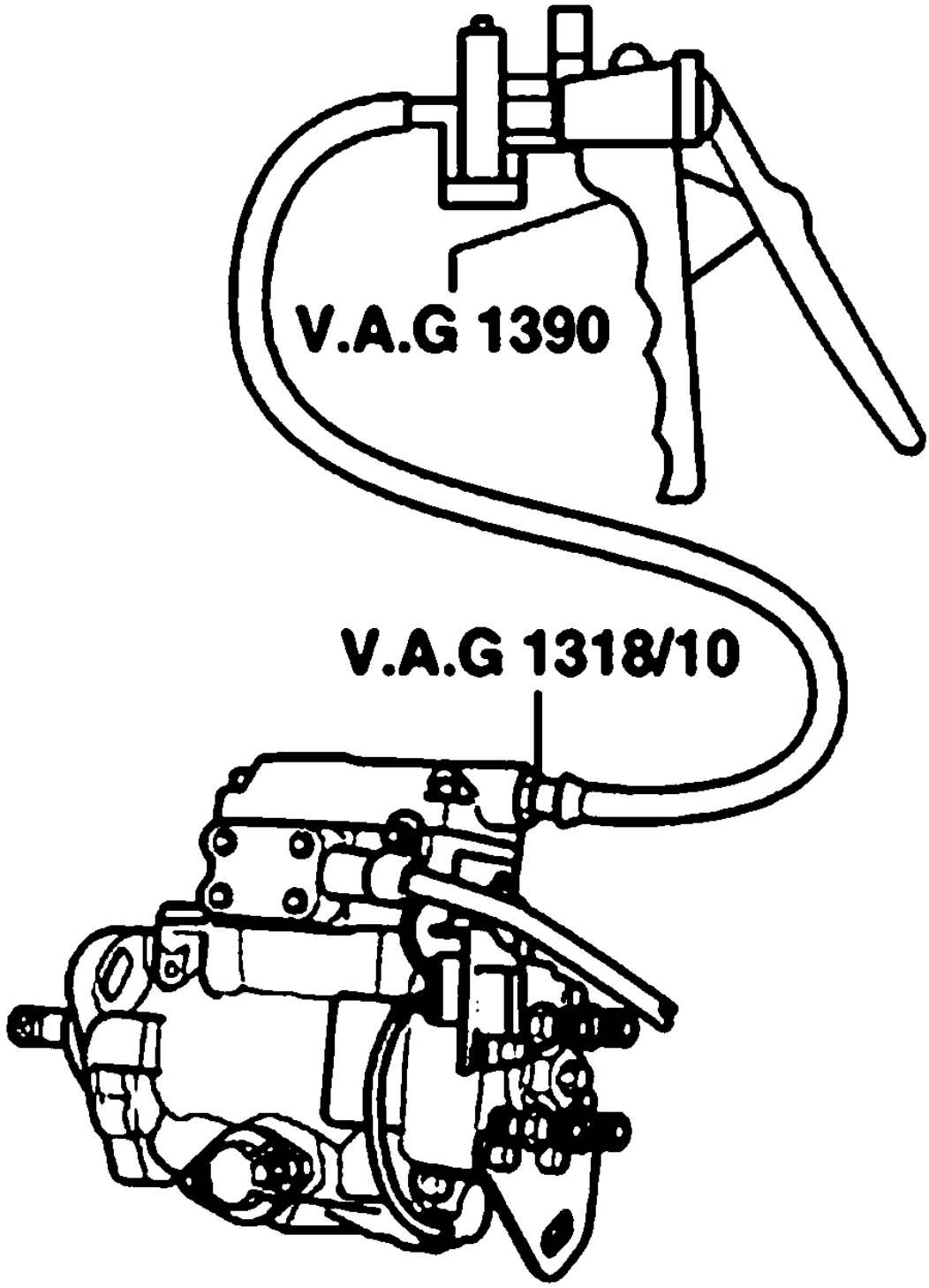

Fig. 18: Filling Injection Pump Using V.A.G. 1390 & 1318/10

Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Operate vacuum pump until fuel flows out of return/supply opening.
  - Do not draw fuel into vacuum pump.
- Remove adapter and connect return/supply line.
- Install valve cover and vacuum pump.
- Dynamically check Start of injection and adjust if necessary. See **START OF INJECTION, DYNAMICALLY CHECKING AND ADJUSTING** .

START OF INJECTION, DYNAMICALLY CHECKING AND ADJUSTING

Special tools

- VAG1331 Torque wrench 5 to 50 Nm (3.7 to 37 ft lb) or equivalent

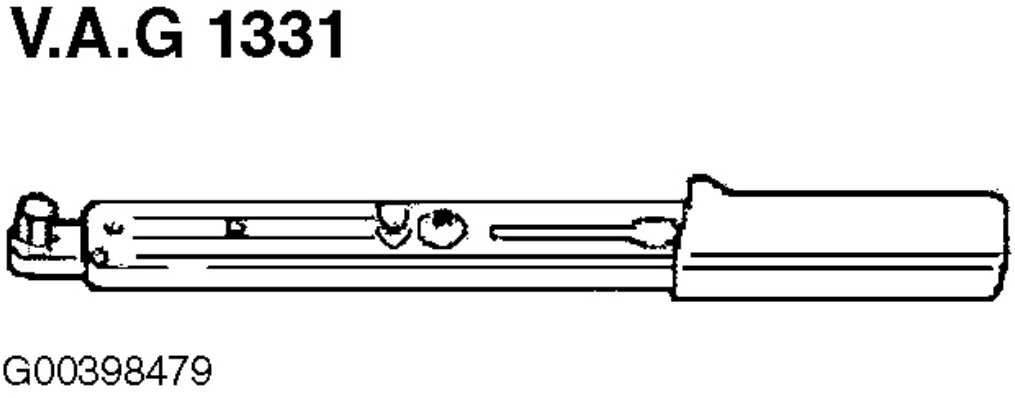

Fig. 19: Identifying Torque Wrench VAG 1331
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- VAG1551/1552 Scan Tool using VAG1551/3 Adapter cable
- 3035 Injection line wrench

NOTE:

- **Dynamically checking and correcting Start of injection is only possible in Function 04, "Basic setting".**
- **Start of injection must always be checked after replacing the toothed belt or loosening the injection pump bolts or toothed belt sprockets and if necessary, adjusted.**

Checking and adjustment conditions

- Mechanical engine settings OK.
- Toothed belt tension OK.

Work sequence

- Connect VAG1551/1552 Scan Tool.
- Start engine and let idle.
- Press -0- and -1- buttons to select Address word 01: "Engine electronics"

  Display will appear as shown (example only)

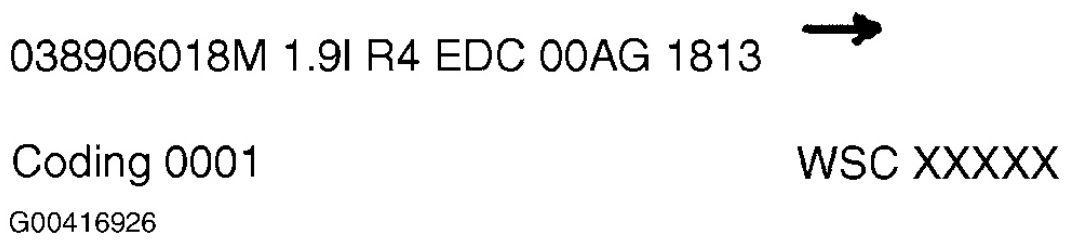

Fig. 20: Scan Tool Display Screen (1 Of 4)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press "right arrow" button

  Display will appear as shown

Fig. 21: Scan Tool Display Screen (2 Of 4)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press -0- and -4- buttons to select Function 04: "Basic setting"
- Press -Q- button to enter input.

Display will appear as shown

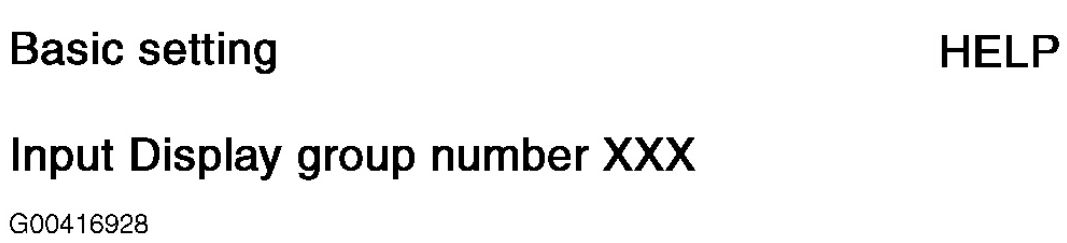

Fig. 22: Scan Tool Display Screen (3 Of 4)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press -0-, -0-, -0- button to select "Display group 0".
- Press -Q- button to enter input.

Display will appear as shown (1 to 10 Display zones)

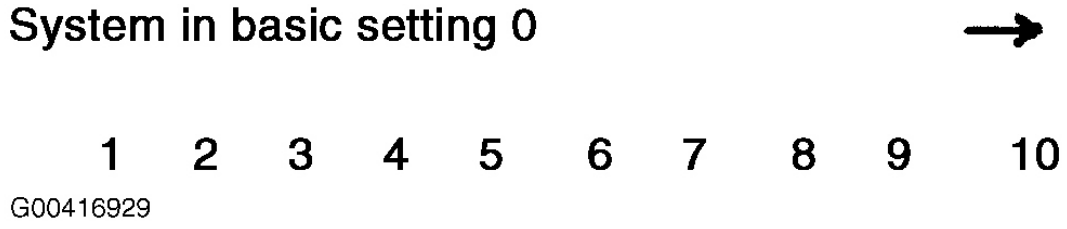

Fig. 23: Scan Tool Display Screen (4 Of 4)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Check Engine Coolant Temperature in Display zone 7.
  - Specification: less than 73 (equates to 85° C)

Continue check only when Engine Coolant Temperature is obtained:

Start of injection (in Display zone 2) is dependent on the Fuel temperature in Display zone 9.

NOTE: The following list refers to items in Fig. 24 .

A. Display zone 2 Start of injection
B. Display zone 9 Fuel temperature

C. Specified range for Start of injection

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Fig. 24: Start Of Diesel Fuel Injection Graph
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Example:

Value 90 in Display zone 9 (B) corresponds to a numerical range from 35 to 74 in Display zone 2 (A).

NOTE: If, when checking Start of injection, the specifications are within zone -C-, no adjustment is required. After repairs, e.g. removing and installing injection pump or adjusting timing, Start of injection must be set to the mean value (dashed line) in zone -C-.

If Start of injection is outside specification, adjust as follows:

- Remove connecting line between charge air cooler and intake manifold.
- Remove upper toothed belt guard.
- Loosen two injection pump sprocket mounting bolts -1-.
- Place 22 mm box wrench onto hub nut -2- to counter-hold pump shaft.

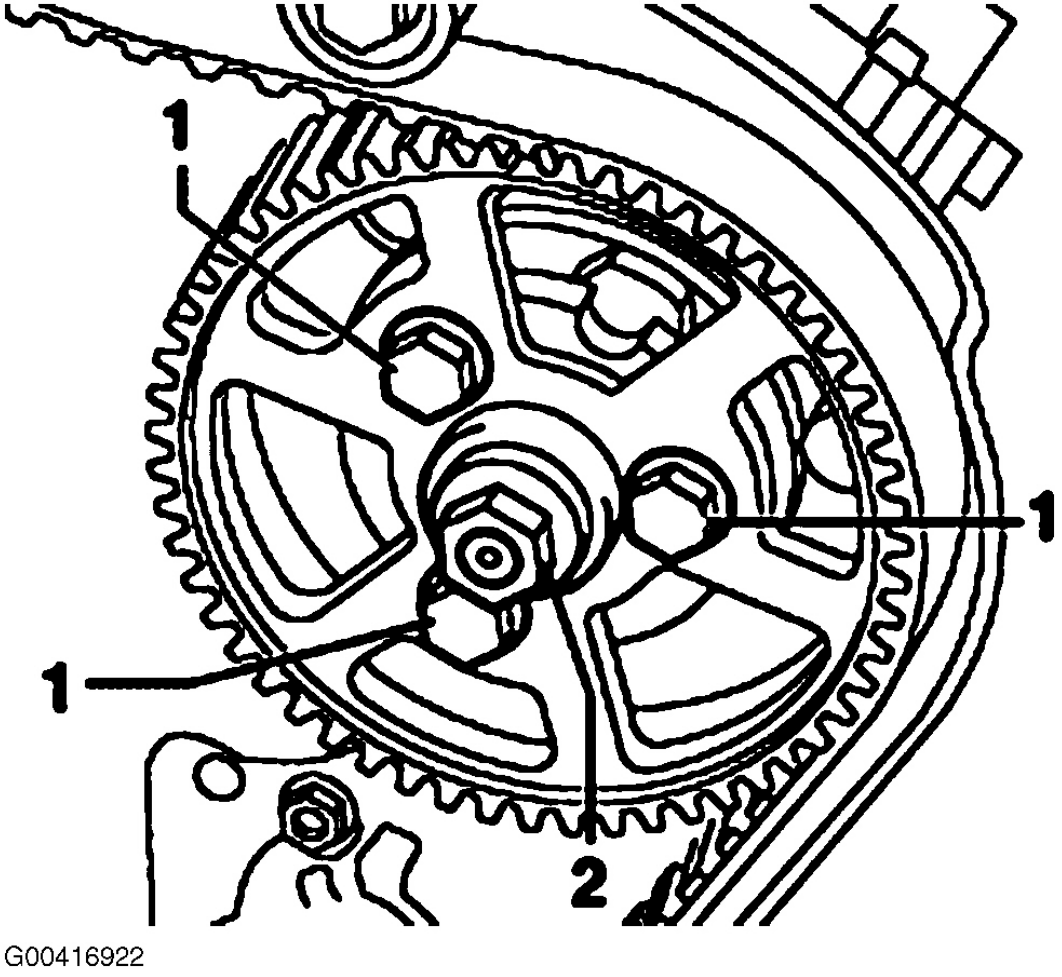

Fig. 25: Injection Pump Sprocket Mounting Bolts
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Loosen 3rd injection pump sprocket mounting bolt and slightly turn pump shaft
  - Left = advance Start of injection
  - Right = retard Start of injection

CAUTION: Do not loosen hub nut -2- for ANY reason. Otherwise, the Diesel injection pump basic setting will be altered and cannot be reset with normal workshop equipment.

- Tighten new mounting bolts for injection pump sprocket.
  - 20 Nm (15 ft lb)

If injection pump has not previously been removed and installed

- Screw in new injection pump sprocket mounting bolts one after the other.
- Observe values in zone 2 and adjust again, if necessary, until the mean value for specification zone -C- is displayed.
- Tighten injection pump sprockets 1/ 4 turn (90°) additional.
- Press "right arrow" button.

Display will appear as shown:

Fig. 26: Scan Tool Display Screen
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Press -0- and -6- buttons to select Function 06: "End output".
- Press -Q- button to enter input.
- Erase DTC memory and set the readiness code CLEARING DIAGNOSTIC TROUBLE CODES (FUNCTION 0 .

FUEL INJECTORS, REMOVING AND INSTALLING

Special tools

- VAG1331 Torque wrench (5 to 50 Nm) or equivalent

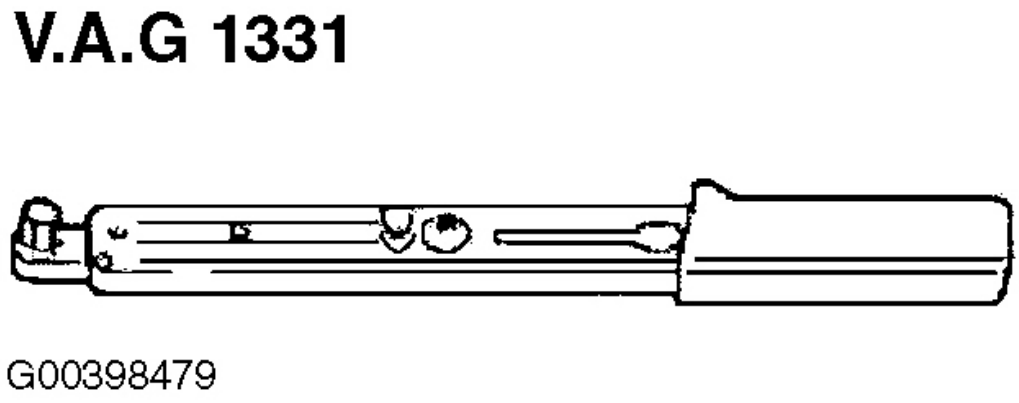

Fig. 27: Identifying Torque Wrench VAG 1331
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- 3035 Injector line wrench

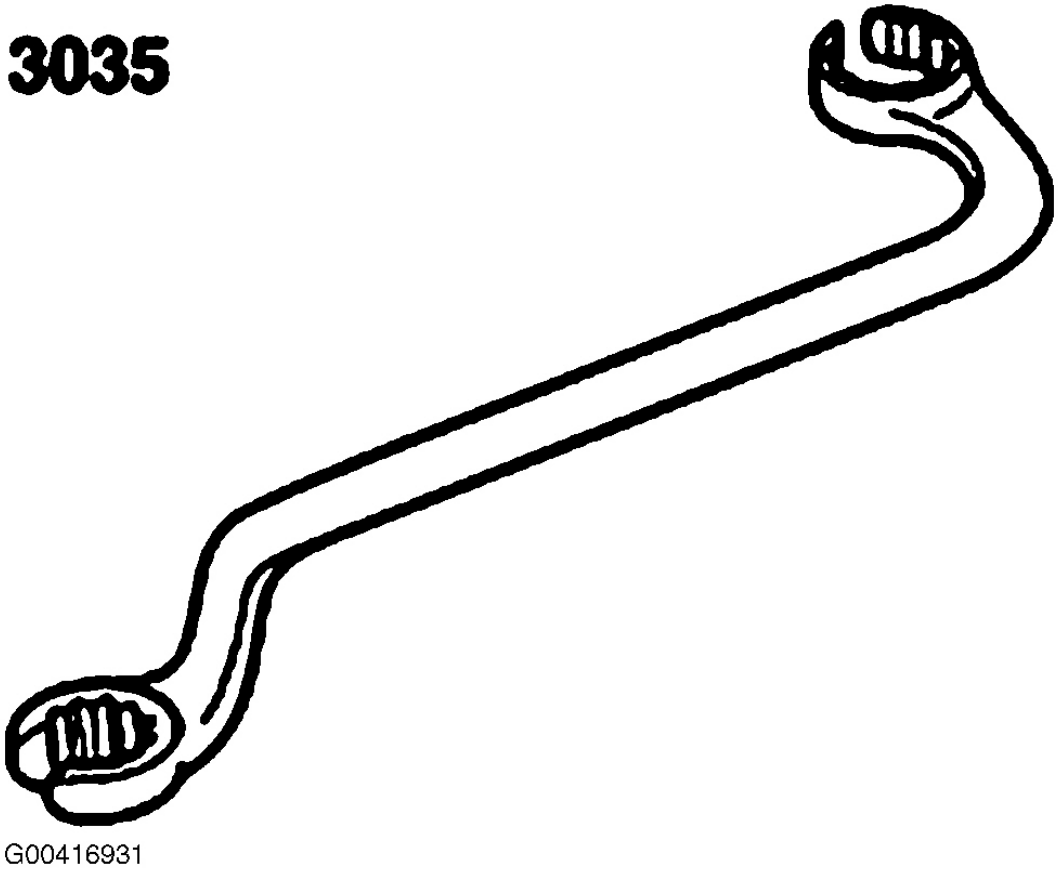

Fig. 28: Identifying 3035 Injector Line Wrench
Courtesy of VOLKSWAGEN UNITED STATES, INC.

NOTE: **Faulty injectors can cause the following malfunctions:**

- **Misfiring**
- **Knocking in one or more cylinders**
- **Engine over-heating**
- **Loss of power**
- **Excessive black exhaust smoke**
- **Higher fuel consumption**
- **Excessive blue smoke when starting with cold engine**

NOTE: **Faulty injectors can be located by loosening the high pressure line connection on each injector in turn with the engine running at a fast idle. If engine speed remains constant after loosening a line connection, this would indicate a faulty**

injector.

FUEL INJECTORS, REMOVING

- Remove injection lines using 3035 tubing wrench.

NOTE: Always remove fuel lines in a complete set. Do not alter line shape.

- Remove mounting nut, retainer and pull out fuel injector.

FUEL INJECTORS, INSTALLING

NOTE: Always replace heat shield between cylinder head and fuel injectors.

- Insert fuel injector.
- Make sure mount is seated correctly in cylinder head and install retainer.

  Tightening torques:
  - Injection lines = 25 Nm (18 ft lb)
  - Retainer screw = 20 Nm (15 ft lb)

- Erase DTC memory and set the readiness.

FUEL INJECTORS, SERVICING

The AHL engine is equipped with dual spring design injectors. Fuel is injected in 2 stages. These fuel injectors must be replaced if malfunctions occur because neither servicing nor pressure adjustment is possible.

Special tools

- VAG1322 Injector test stand with VAG1322/2 pressure line

Checking requirements

- Pressure gauge on

FUEL INJECTION PRESSURE, CHECKING

WARNING: When testing fuel injectors, make sure that the stream of fuel does not contact your hands. The high pressure fuel delivery can penetrate skin which could result in severe injuries.

- Connect fuel injector to fuel injector test stand.

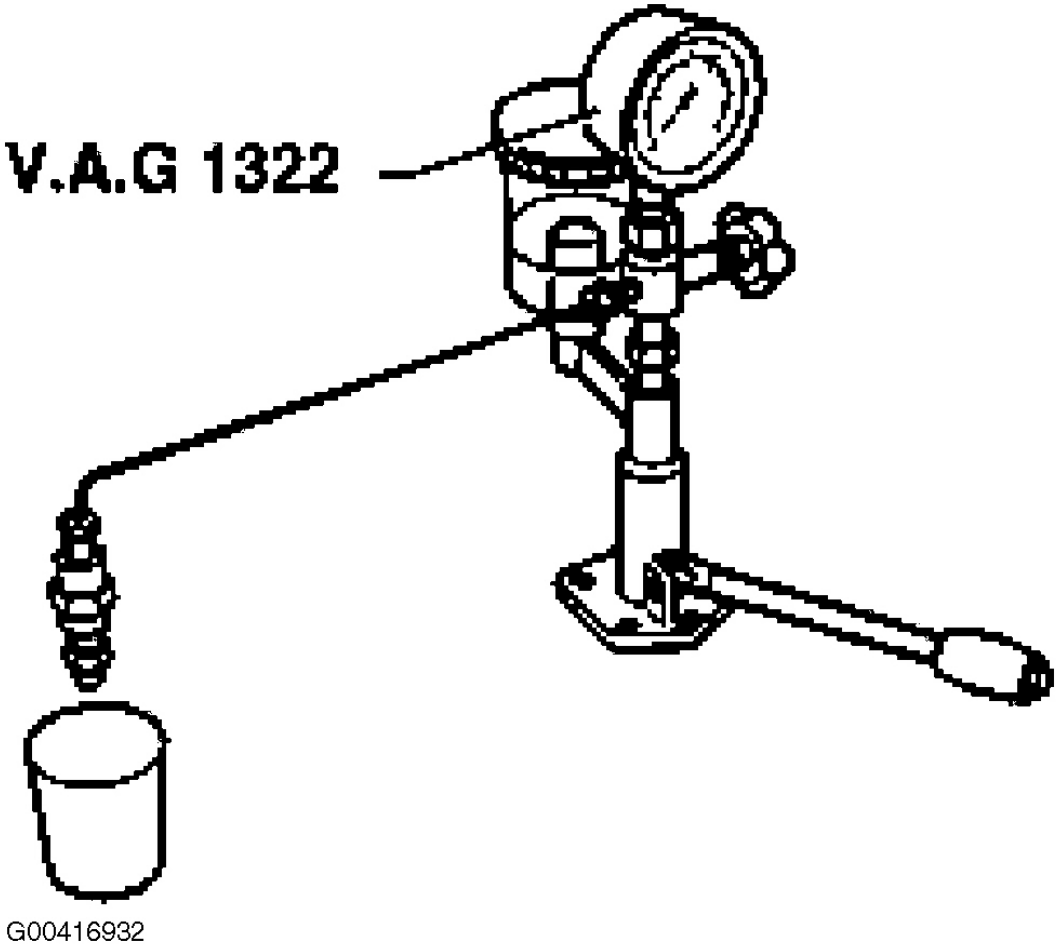

Fig. 29: Identifying V.A.G. 1322
Courtesy of VOLKSWAGEN UNITED STATES, INC.

- Move pump lever down slowly. When spray begins, record opening pressure for deviations from specification replace injector.
  - Specification (new injectors): 220 - 230 bar
  - Wear limit: 200 bar

FUEL INJECTORS, LEAK-CHECKING

- Pressure gauge on
  - Move pump lever down slowly and maintain a pressure of approx. 150 bar for 10 seconds.
- No fuel should leak from the nozzle tip.
  - If any injector(s) leak, replace.

DIESEL INJECTION PUMP TIMING COVER O-RING, REPLACING

- Place a clean cloth under the Diesel injection pump.
- Remove cover screws -1- with commercially available tool for Torx socket head screws, e.g. Hazet 2115-T30.
- Remove cover -2- and clean thoroughly.
- Replace O-ring -3- and install cover using existing shims -4-.

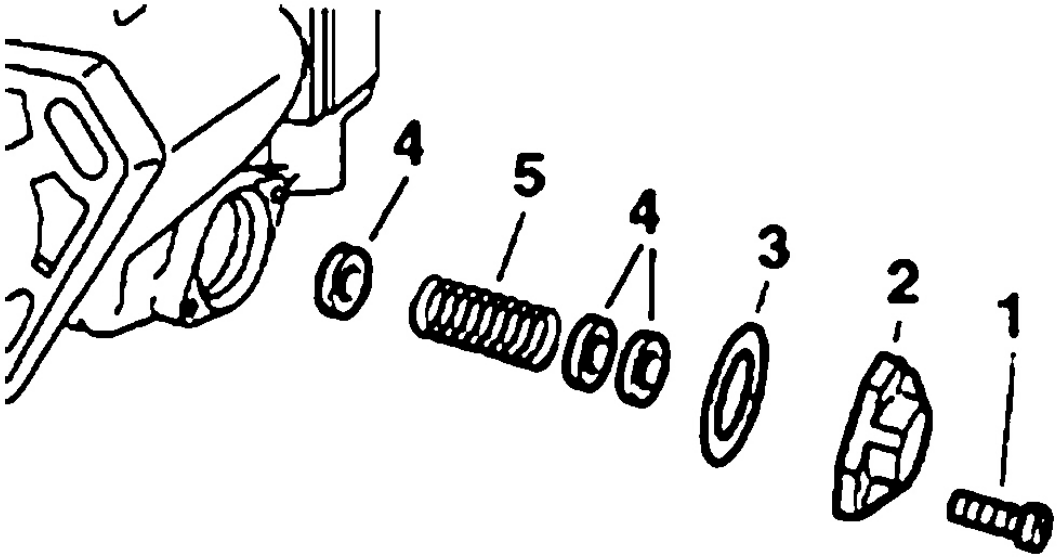

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Fig. 30: Diesel Injection Pump Timing Cover Components
Courtesy of VOLKSWAGEN UNITED STATES, INC.

DIESEL DIRECT INJECTION SYSTEM, SERVICING

The diesel direct injection system control module is equipped with a fault memory. Check the fault memory before/after performing repairs or adjustments, See **ENGINE CONTROL MODULE (DTC) MEMORY, READING AND ERASING** .

Safety precautions, See **SAFETY PRECAUTIONS** .

Rules for cleanliness, See **RULES FOR CLEANLINESS** .

SAFETY PRECAUTIONS

CAUTION: When performing repair work, especially due to the confined conditions in the engine compartment, pay attention to the following:

- **Route all types of hoses/lines (e.g. for fuel, hydraulics, EVAP system, coolant, refrigerant, brake fluid and vacuum) as well as electrical wiring so that the original positions are restored.**
- **Ensure sufficient clearance to all moving or hot components.**

To prevent injuries to persons and/or damage to the fuel injection and glow plug system, observe the following:

- The ignition must be switched off before connecting or disconnecting the glow plug system or injection system wiring or tester cables.
- If the engine is to be turned over at starter speed without starting, e.g. for compression pressure test, separate connection for injector unit at cylinder head.
- Before disconnecting the battery Ground (GND) strap obtain the code for radios with anti-theft coding.
- Disconnecting and connecting the battery must only be done with the ignition switched off, otherwise the diesel direct injection system control module could be damaged.

Observe the following if test and measuring instruments are required during a road test:

- Test and measuring instruments must be secured to rear seat and operated by an assistant from this location.

If test and measuring instruments are operated from front passenger's seat and the vehicle is involved in an accident, there is a possibility that the person sitting in this seat may receive serious injuries when the airbag is triggered.

RULES FOR CLEANLINESS

When working on the fuel supply/injection system, pay careful attention to the following rules:

- Thoroughly clean all unions and adjacent areas before disconnecting.
- Place parts that have been removed on a clean surface and cover. Do not use fluffy cloths!
- Carefully cover opened components or seal if repairs cannot be carried out immediately.
- Only install clean components:

  Only unpack replacement parts immediately prior to installation.

  Do not use parts that have been stored loose (e.g. in tool boxes etc.).

- When system is open:

  Do not work with compressed air if this can be avoided.

  Do not move vehicle unless absolutely necessary.

- Make sure that no diesel fuel runs onto the coolant hoses. Immediately clean any accidental hose contamination. Affected hoses must be replaced.

DIESEL DIRECT INJECTION SYSTEM, COMPONENT LOCATIONS OVERVIEW

NOTE: The following list refers to items in Fig. 1 . The components A to C are not shown on the illustration.

A. **Brake Pedal Switch (cruise control/Diesel Direct Fuel Injection) -F47-**
   - In footwell on brake pedal

B. Brake light switch -F-
   - In footwell on brake pedal

C. **Throttle Position (TP) sensor -G79-**
   - In footwell on accelerator pedal

NOTE: The following list refers to items in Fig. 1 .

1. **Engine Coolant Temperature (ECT) sensor -G62-**
   - For engine control module.
   - With Engine Coolant Temperature (ECT) Sensor -G2-
   - If necessary, release pressure in cooling system before removing.
2. **Intake manifold flap**
   - With Motor for intake flap -V157-
3. **EGR Vacuum Regulator Solenoid Valve -N18-**
4. **Positive Crankcase Ventilation (PCV) Heating Element -N79-**

5. **Diesel Direct Fuel Injection (DFI) Engine Control Module (ECM) -J248-**
    - With Barometric Pressure (BARO) Sensor -F96-
    - Replacing, See **ENGINE CONTROL MODULE**
6. **Intake Manifold Runner Control (IMRC) Valve -N316-**
7. **Exhaust Gas Recirculation (EGR) Cooler Switch-over Valve -N345-**
8. **Wastegate Bypass Regulator Valve -N75-**
9. **Mass Air Flow (MAF) Sensor -G70-**
10. **Connector**
    - For injector unit (-N240- to -243-)
11. **Engine Speed (RPM) Sensor -G28-**
12. **Fuel Temperature Sensor -G81-**
13. **Connector**
    - For Engine Speed (RPM) Sensor -G28-
14. **Connector**
    - For Camshaft Position (CMP) Sensor -G40-,
15. **Camshaft Position (CMP) Sensor -G40-**
    - For camshaft position
16. **Manifold Absolute Pressure (MAP) Sensor -G71- with Intake Air Temperature (IAT) Sensor -G72-**

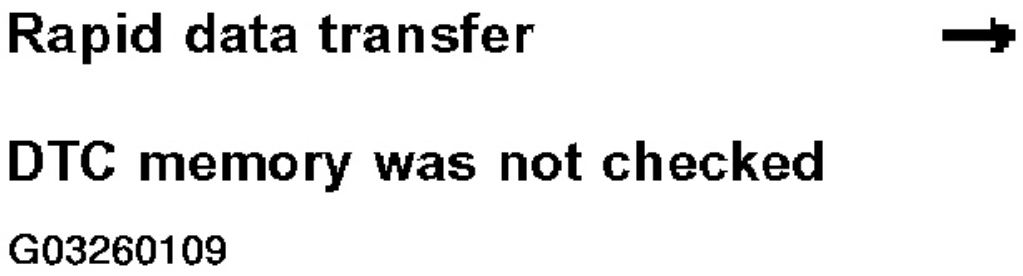


Fig. 1: Diesel Direct Injection System Component Locations Overview
Courtesy of VOLKSWAGEN OF AMERICA, INC.

VARIABLE INTAKE MANIFOLD, SERVICING

The variable intake manifold is switched depending on engine speed and accelerator pedal position.

NOTE: The following list refers to items in Fig. 2 .

1. **22 N.m**
2. **Connecting pipe**
   - From cooler for exhaust gas recirculation. See **EXHAUST GAS RECIRCULATION SYSTEM COMPONENTS, REMOVING AND INSTALLING** .
3. **Seal**
   - Always replace
4. **Intake manifold upper part**
5. **O-ring**
   - Always replace
6. **EGR Vacuum Regulator Solenoid Valve -N18-**
7. **10 N.m**
8. **O-ring**
   - Always replace
9. **Intake manifold flap**
   - With Motor for intake flap -V157-
10. **10 N.m**
11. **Seal**
    - Always replace
12. Seal
    - Always replace.
13. **Intake manifold lower part**
    - with selector shaft
14. **10 N.m**
    - Note tightening sequence. See **VARIABLE INTAKE MANIFOLD, DISASSEMBLING AND ASSEMBLING**
15. **Bracket**
16. **10 N.m**
17. **Vacuum actuator**
18. **Vacuum hose**
19. **Intake Manifold Runner Control (IMRC) Valve -N316-**
    - Vacuum hoses for connection diagram. See **VACUUM HOSE CONNECTION DIAGRAM** .

Fig. 2: Exploded View Of Variable Intake Manifold
Courtesy of VOLKSWAGEN OF AMERICA, INC.

VARIABLE INTAKE MANIFOLD, DISASSEMBLING AND ASSEMBLING

NOTE: To avoid distortion of the variable intake manifold it must only be tightened in the described sequence:

- Remove variable intake manifold.
- Loosen connecting bolts.
- Disconnect upper and lower part of intake manifold. Separate both parts with light blows of a rubber headed hammer if necessary.
- Clean contact surface.
- Replace seal.
- Put upper and lower part of intake manifold together and tighten all connecting bolts hand-tight.
- Tighten all securing bolts in indicated sequence to 10 N.m.

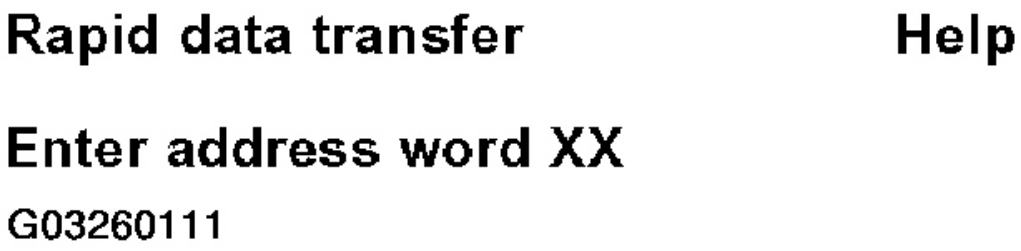


Fig. 3: Tightening Sequence Of Upper & Lower Intake Manifold Securing Bolts

Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install variable intake manifold.

INJECTOR UNIT, SERVICING

- Observe rules for cleanliness. See **RULES FOR CLEANLINESS** .
- Always replace sealing and O-rings.

NOTE: The following list refers to items in Fig. 4 .

1. **20 N.m plus an additional 1/4 turn (90°)**
   - Always replace
   - Note sequence when loosening and tightening. See **INJECTOR UNIT, REMOVING AND INSTALLING** .
2. **Rocker shaft**
   - With rocker lever
   - Removing and installing, See **INJECTOR UNIT, REMOVING AND INSTALLING** .
3. **Lock nut, 30 N.m**
4. **Adjustment screw**
   - Replace when installing a new injector unit or if worn
   - Adjusting, see **INJECTOR UNIT, REMOVING AND INSTALLING**
5. **Unit injector**
   - Check ball pin for wear, replace if necessary
   - Removing and installing, see **INJECTOR UNIT, REMOVING AND INSTALLING**
6. **O-ring**
   - Replacing, See **O-RINGS FOR INJECTOR UNIT, REMOVING AND INSTALLING**
7. O-ring
   - Replacing, See **O-RINGS FOR INJECTOR UNIT, REMOVING AND INSTALLING**
8. **O-ring**
   - Replacing, See **O-RINGS FOR INJECTOR UNIT, REMOVING AND INSTALLING**
9. **Heat protection gasket**
   - Always replace
10. **Circlip**
11. **Cylinder head**
12. **Scotch block**
13. **12 N.m plus an additional 3/4 turn (270°)**
    - Always replace

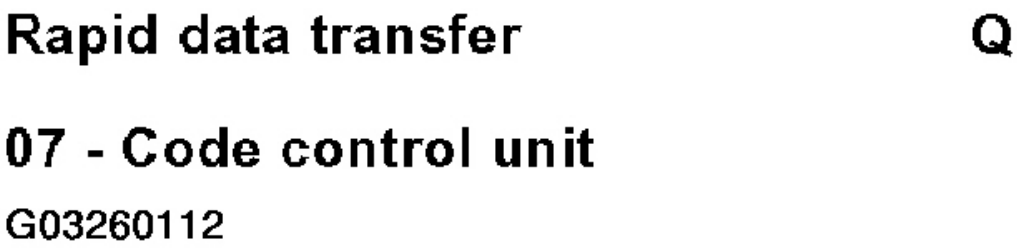


Fig. 4: Injector Unit Components
Courtesy of VOLKSWAGEN OF AMERICA, INC.

O-RINGS FOR INJECTOR UNIT, REMOVING AND INSTALLING

Special tools and equipment

- T10056 Assembly sleeves Removing

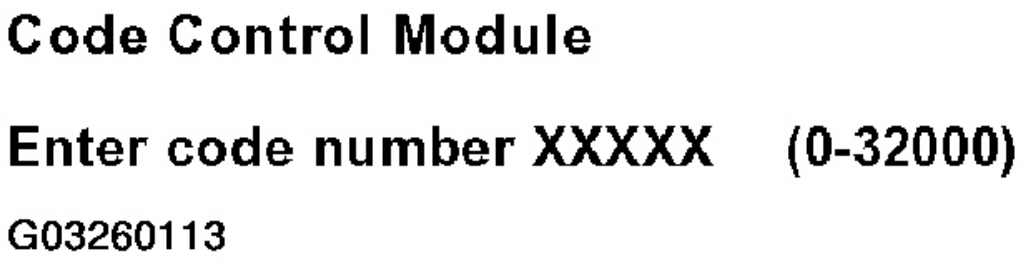


Fig. 5: Identifying T10056 Assembly Sleeves
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove injector unit, See **INJECTOR UNIT, REMOVING AND INSTALLING** .
- Carefully remove old O-rings from injector unit.

Installing

NOTE:

- **Always use assembly sleeves to install the O-rings. Otherwise the O-rings will be damaged.**

- **Gradual introduction of O-rings without different color identification. Observe correct application of the O-rings to the grooves: the ring thickness decreases towards the injector.**
- **Avoid rolling movements when sliding onto the O-rings. The O-rings must not be twisted in the injector unit seat.**

- Pull heat protection gasket off together with safety ring.
- Carefully clean contact surfaces for O-rings at injector unit.
- Install assembly sleeve T10056/1 on injector unit onto limit stop.

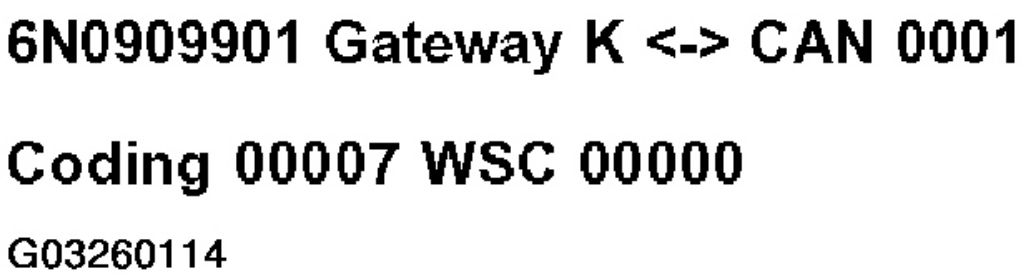


Fig. 6: Installing Assembly Sleeve T10056/1 On Injector Unit Onto Limit Stop
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Carefully slide upper thicker O-ring on assembly sleeve and in injector unit seat.
- Remove assembly sleeve.
- Install assembly sleeve T10056/2 on injector unit onto limit stop.
- Carefully slide center thinner O-ring on assembly sleeve and in injector unit seat.
- Remove assembly sleeve.

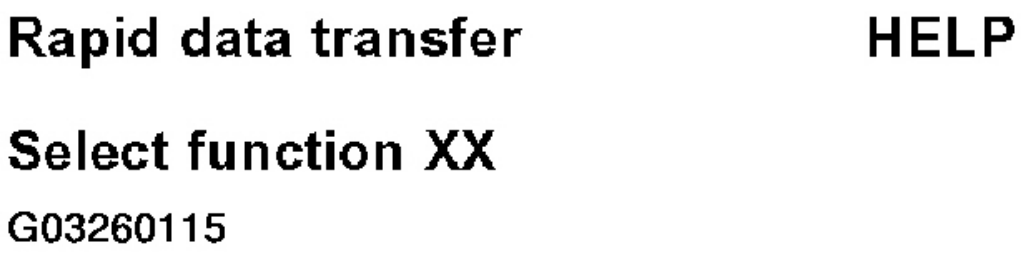


Fig. 7: Installing Assembly Sleeve T10056/2 On Injector Unit Onto Limit Stop
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install assembly sleeve T10056/3 on injector unit onto limit stop.

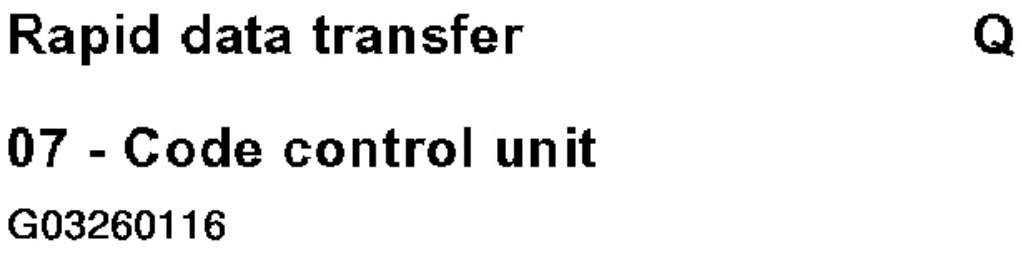


Fig. 8: Installing Assembly Sleeve T10056/3 On Injector Unit Onto Limit Stop
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Carefully slide lower O-ring on assembly sleeve and in injector unit seat.
- Remove assembly sleeve.
- Slide on a new heat protection gasket together with safety ring.
- Install injector unit, See **INJECTOR UNIT, REMOVING AND INSTALLING** .

INJECTOR UNIT, REMOVING AND INSTALLING

Special tools and equipment

- VW 387 Universal dial gauge bracket
- 3410 Socket

- T10054 Socket
- T10055 Puller
- V.A.G1331 Torque wrench (5 to 50 N.m)
- Dial gauge

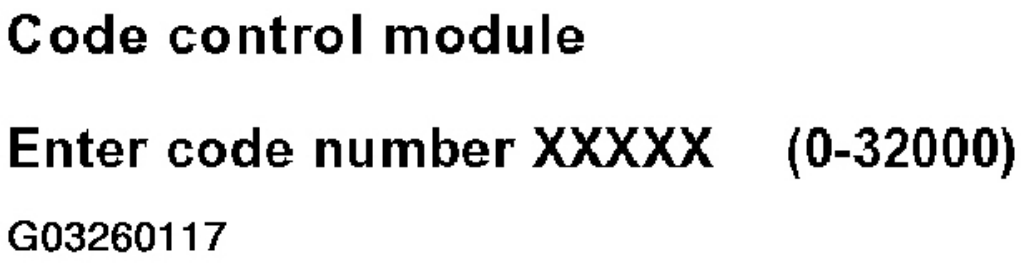


Fig. 9: Identifying Special Tools And Equipment
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove toothed belt upper part and cylinder head cover. See **CYLINDER HEAD, REMOVING AND INSTALLING** .
- Turn crankshaft until cam pair of injector unit to be installed/removed points evenly upward.
- Loosen adjustment screw lock nuts -1- and unscrew adjustment screws until respective locker lever lies on injector unit spring. See **Fig. 10** .
- Loosen securing bolts -2- for rocker shaft (starting on outside and working inward) with socket insert 3410 and take rocker shaft off.
- Loosen scotch block securing bolt -3- with socket insert T10054 and remove scotch block.

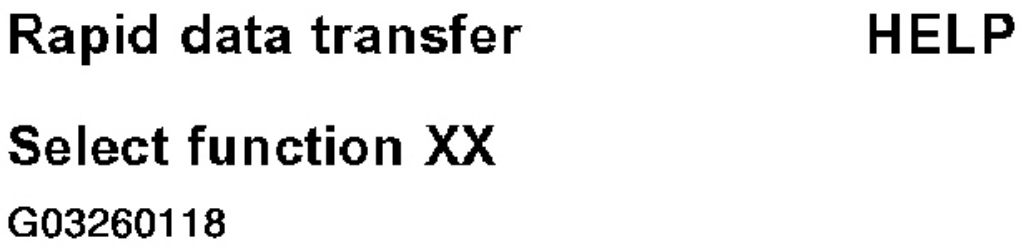


Fig. 10: Removing Scotch Block
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Pry up unit injector connector with a screwdriver. To avoid canting support other side of connector with light finger pressure.

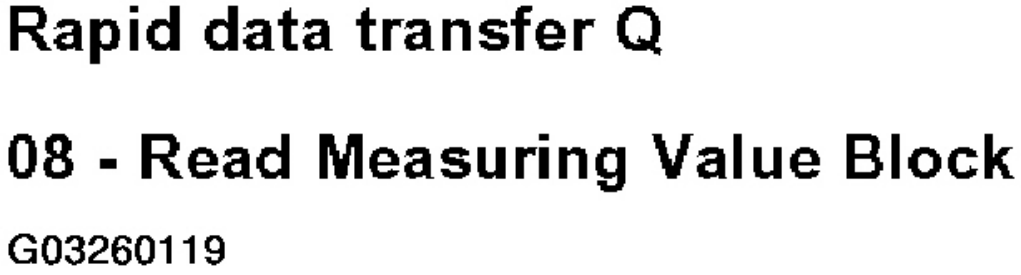


Fig. 11: Prying Up Unit Injector Connector With Screwdriver
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Insert puller instead of scotch block into slot of injector unit.
- Pull injector unit off by knocking it outward of cylinder head seat.

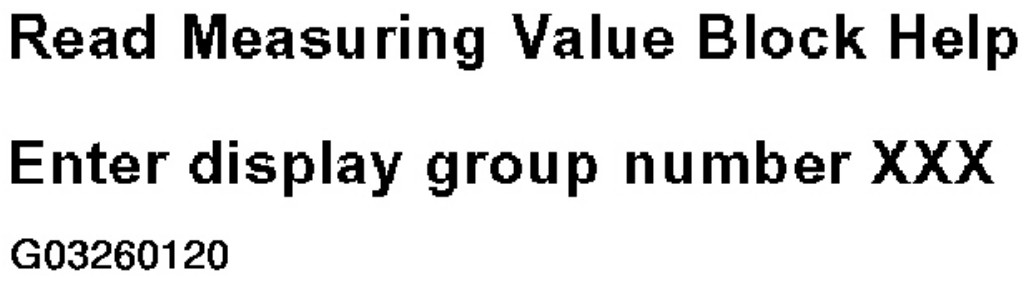


Fig. 12: Removing Injector Unit
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing

NOTE:

- **If a new injector unit is installed, the respective adjustment screw in the rocker lever must also be replaced.**
- **For every repair which requires an adjustment of the injector unit, the locker lever adjustment screw and the injector unit ball pin must be cleaned and checked for wear. If worn replace the ball pin and adjustment screw.**
- **New injector units are supplied with O-rings and heat protection gasket.**

If the old injector unit is installed, the O-rings and heat protection gasket must be replaced, See **O-RINGS FOR INJECTOR UNIT, REMOVING AND INSTALLING** .

- Check correct seat of three O-rings, heat protection gasket and safety ring before installing injector unit.

NOTE: **The O-rings must not be twisted.**

- Oil O-rings and insert injector unit with greatest care in cylinder head seat.
- Install injector unit into cylinder head seat onto limit stop by pressing it evenly.
- Insert scotch block into slot of injector unit.

NOTE: **If the injector unit is not positioned at right angles to the scotch block the securing bolt could loosen and cause damage to the injector unit or the cylinder head.**

Align injector unit as follows:

- Screw new securing bolt into scotch block until injector unit can still be turned lightly.
- Align injector unit at right angles to bearing pedestals of camshaft.
- Use a vernier gauge (measuring range at least 400 mm) and check dimension "a" from cylinder head outer edge to round surface of injector unit. See **Fig. 13** and **DIMENSION "A" FROM CYLINDER HEAD OUTER EDGE TO ROUND SURFACE OF INJECTOR UNIT** .

DIMENSION "A" FROM CYLINDER HEAD OUTER EDGE TO ROUND SURFACE OF INJECTOR UNIT

Cylinder	Dimension "a"
1	333.0 +/-0.8 mm
2	245.0 +/-0.8 mm
3	153.6 +/-0.8 mm
4	65.6 +/-0.8 mm

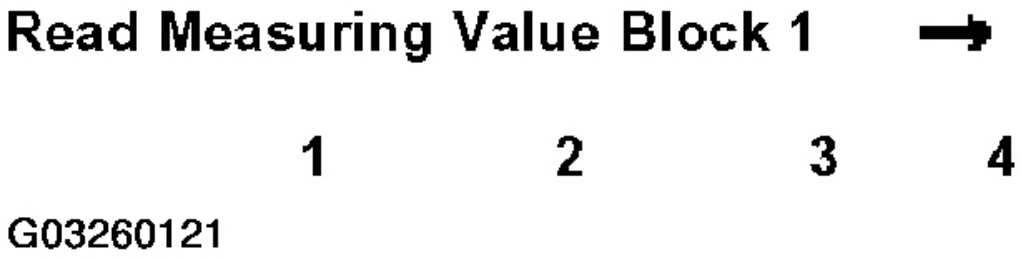


Fig. 13: Checking Dimension "a" From Cylinder Head Outer Edge To Round Surface Of Injector Unit
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Align injector unit again, if necessary, and tighten securing bolt as follows:
- Tighten securing bolt to 12 N.m plus an additional 270° (3/4 turn). Turning further can be done in several stages.
- Position rocker shaft and tighten new securing bolts as follows:

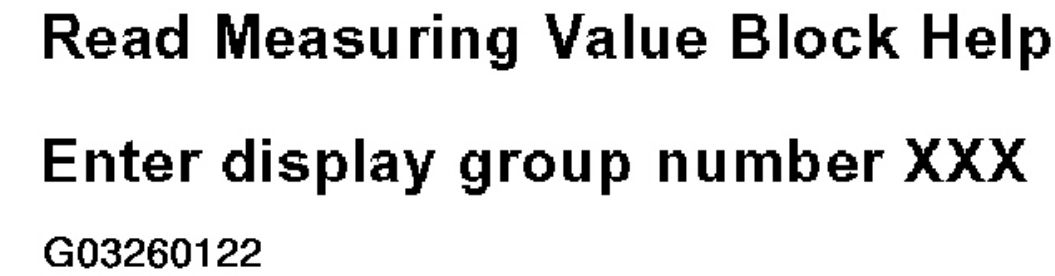


Fig. 14: Positioning Rocker Shaft And Tightening New Securing Bolts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Tighten inner bolts -2- first and then outer screws -1- hand-tight. Then in same sequence to:

  20 N.m and 90°(1/4 turn further).

- Install a dial gauge on injector unit adjustment screw as shown in **Fig. 15** .

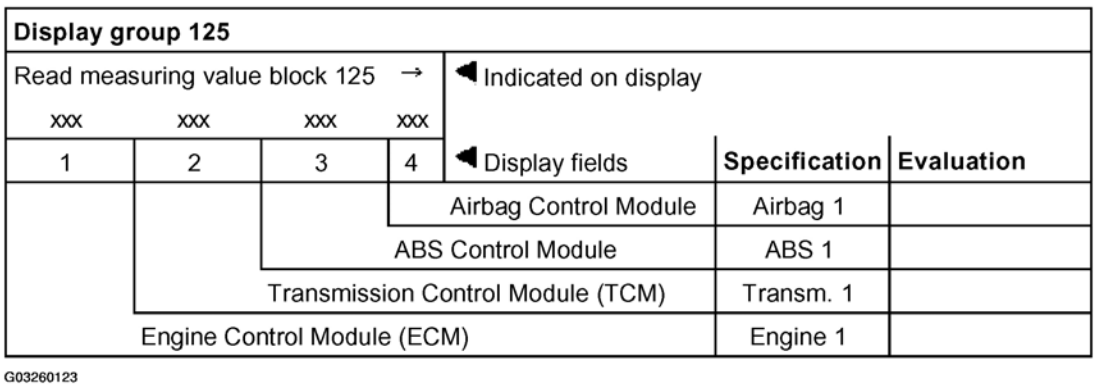


Fig. 15: Installing Dial Gauge On Injector Unit Adjustment Screw
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Turn crankshaft in engine direction of rotation, until rocker lever roller is positioned on actuating cam point.

  Roller side (arrow -A-) is at highest point

  Dial gauge (arrow -B-) is at lowest point

- Remove dial gauge.

- Install adjustment screw into rocker lever until a considerable resistance can be felt (injector element is onto limit stop).
- Turn adjustment screw back from top around 225°.
- Hold adjustment screw in this position and tighten lock nut to 30 N.m.

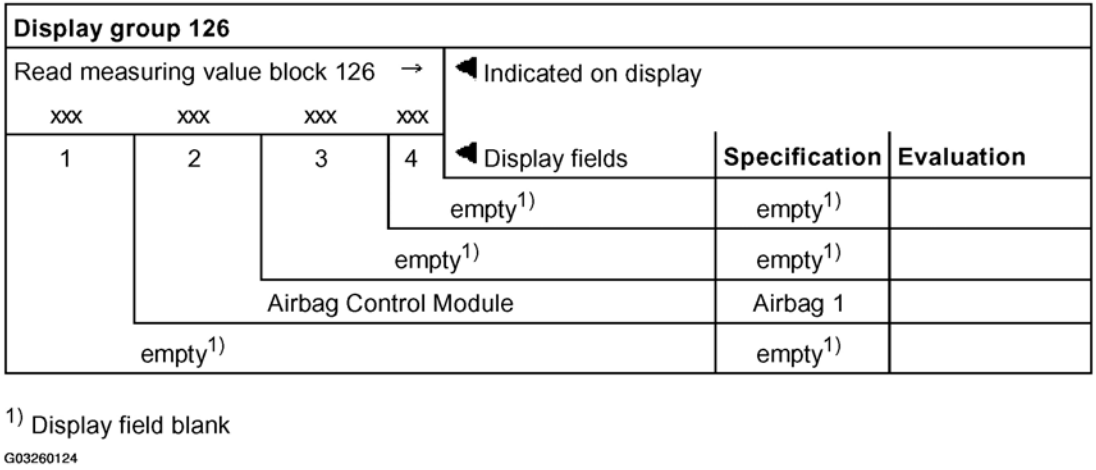


Fig. 16: Holding Adjustment Screw In Position And Tightening Lock Nut
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Position injector unit connector and install cylinder head cover and toothed belt guard, upper part. See **CYLINDER HEAD, REMOVING AND INSTALLING** .

ENGINE CONTROL MODULE

ENGINE CONTROL MODULE, REMOVING AND INSTALLING

- Before removing engine control module check control module identification and thereby previous control module coding, See **ENGINE CONTROL MODULE (DTC) MEMORY, READING AND ERASING** .

Removing

- Switch ignition off.
- Remove inner cover on left hand side of plenum chamber.

  See **PLENUM CHAMBER INNER COVER, REMOVING AND INSTALLING** .

- Carefully press off retaining tab (arrow).

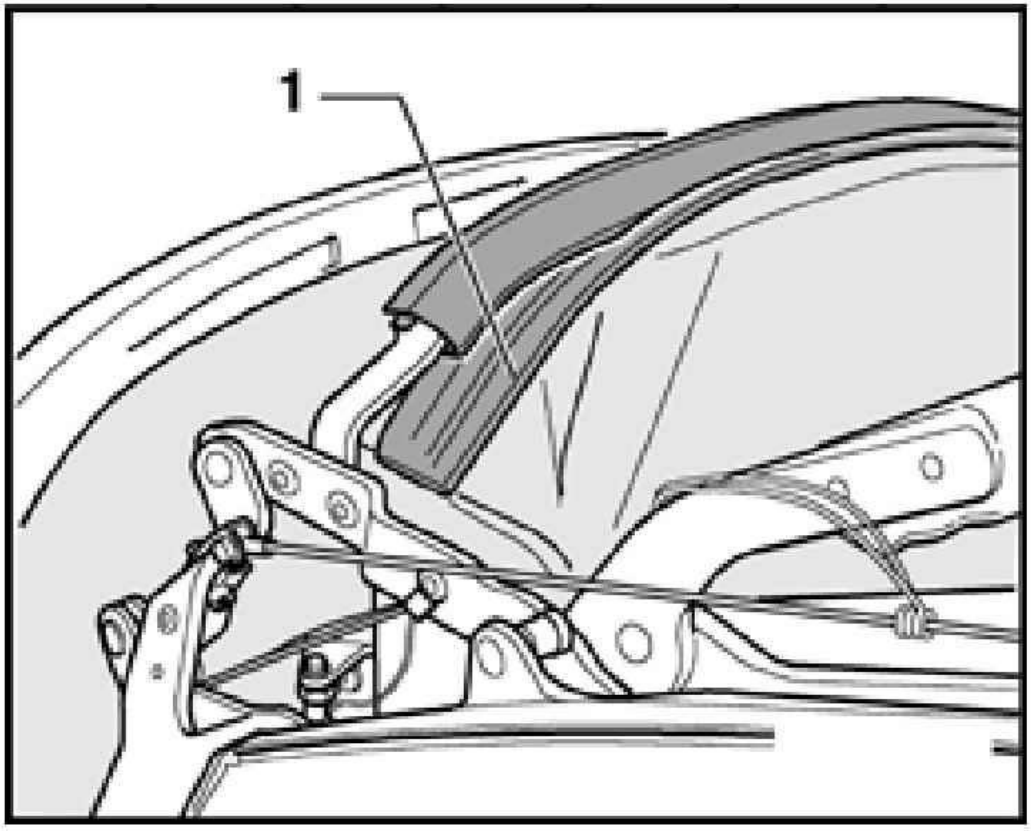


Fig. 17: Pressing Off Engine Control Module Retaining Tab
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Unlock engine control module connector and remove.

Installing

- Install new control module and press to left.
- Connect connector and lock in position.
- Check previous coding and code new control module, See **COMPONENTS, ADAPTING** .

ENGINE CONTROL MODULE (DTC) MEMORY, READING AND ERASING

Special tools and equipment

- VAS 5051 Vehicle Diagnosis, Testing and Information System

- Diagnostic cable VAS 5051/1 or VAS 5051/3

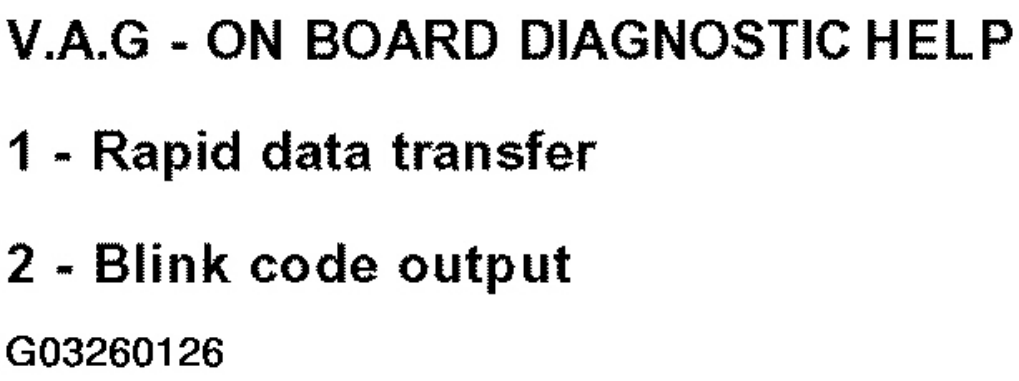


Fig. 18: Identifying VAS 5051 Vehicle Diagnosis, Testing And Information System
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Work sequence

Connect Vehicle Diagnosis, Testing and Information System VAS 5051 as follows:

- Connect connector of diagnosis cable VAS 5051/1 or VAS 5051/3 to diagnosis connection.

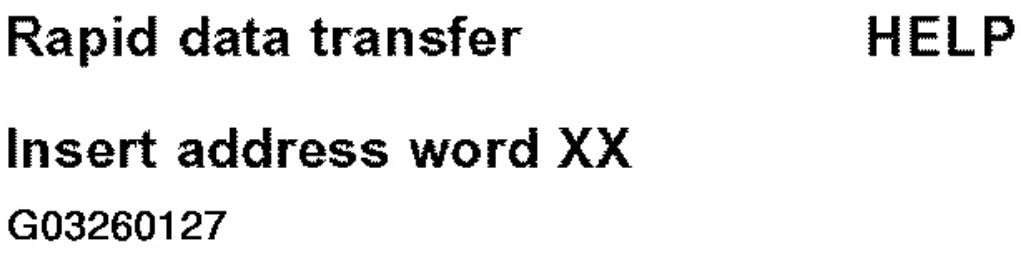


Fig. 19: Connecting Connector Of Diagnosis Cable VAS 5051/1 Or VAS 5051/3 To Diagnosis Connection
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Start engine and run at idling speed.

NOTE: Only when engine does not start:

- Switch ignition on.

Select operating mode

- Press button on screen for "Vehicle self-diagnosis".

Select vehicle system

- Press button "01 - Engine electronics" on screen.

The control module identification and engine control module coding are shown on the screen.

Select diagnostic function

- Press button "02 - Interrogating fault memory" on screen.

  "No fault detected" appears on screen if no DTCs are stored in the engine control module.

If DTCs are stored in the engine control module they will appear on the screen listed one below the other.

- Press <-- button.
- Press button "05 - Erase fault memory" on screen.
- Press function 06-"End output".

COMPONENTS, ADAPTING

Special tools and equipment

- VAS 5051 Vehicle Diagnosis, Testing and Information System
- Diagnostic cable VAS 5051/1 or VAS 5051/3

Fig. 20: Identifying VAS 5051 Vehicle Diagnosis, Testing And Information System
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Select "guided fault finding" in the VAS 5051 tester.

After all control modules have been interrogated:

- Press "Go to" button
- Select "Function/component selection"
- Select "drivetrain"
- Select "engine code"
- "01 Select "01-Systems capable of self-diagnosis"
- Select "engine management system"
- Select "Functions"
- Select "Function or component"

DIESEL FUEL INJECTION

DIESEL DIRECT FUEL INJECTION SYSTEM, SERVICING

The Diesel direct injection system Engine Control Module (ECM) is equipped with a Diagnostic Trouble Code (DTC) memory. Before starting repairs, adjustments and troubleshooting, check DTC memory to see if there are any stored DTCs. See **DTC MEMORY, CHECKING** . Make sure that Function 03: Output Diagnostic Test Mode (DTM) has been performed. See **FUNCTION 03: OUTPUT DIAGNOSTIC TEST MODE, PERFORMING** .

NOTE: Some checking and adjustment procedures can cause DTCs to be stored in DTC memory. For this reason, always erase DTC memory after completing all checking and adjustment procedures. See DTC MEMORY, ERASING . See READINESS CODE, SETTING to Set the Readiness code.

Safety precautions

To prevent injuries to persons and/or damage to the Diesel direct fuel injection and glow plug system, observe the following:

- Switch OFF the ignition before connecting or disconnecting Diesel fuel injection or glow plug system wiring or test cables.
- If the engine requires cranking at starter speed, without starting, e.g. when checking compression, disconnect the N109 Fuel cut-off valve harness connector from the Diesel injection pump.
- Obtain the radio Anti-theft code from the customer BEFORE disconnecting the Battery Ground strap.
- Always make sure that the ignition is switched OFF before disconnecting and connecting the battery. Otherwise, the Diesel direct injection system Engine Control Module could be damaged.

Safety precautions during Test drives

WARNING: Secure Scan Tool to rear seat and operate from this position using a second technician.

- Always attach Test and measuring instruments to the rear seat and operate them using a second technician from this location.

If test and measuring instruments are operated from the front passenger's seat and the vehicle is involved in an accident, there is a possibility that the person sitting in this seat could receive serious injuries if the airbag is triggered.

Rules for cleanliness

When working on the fuel supply/injection system, pay careful attention to the following "6 rules":

- Thoroughly clean all unions and the adjacent areas before disconnecting.
- Place removed parts on a clean surface and cover over but do NOT use fluffy cloths (lint contamination)!
- Carefully cover opened components or seal over, if the repair cannot be carried out immediately.
- Only install clean components:

  Only unpack replacement parts immediately prior to installation.

  Do not use parts that have been stored loose e.g. in tool boxes.

- When the system is open:

  Do not work with compressed air if it can be avoided.

  Do not move the vehicle unless absolutely necessary.

- Make sure that no Diesel fuel runs onto the coolant hoses. Clean contaminated hoses immediately. Always replace affected hoses.

Diesel injection system, component locations overview

Components A, B and C are not shown on the illustration.

A. **Brake vacuum vent valve switch for cruise control/diesel fuel injection -F47- and Brake light switch -F63-**
   - Together in one housing in footwell on brake pedal

B. **Throttle Position (TP) Sensor - G79-**
   - in footwell on throttle pedal

   See **THROTTLE POSITION SENSOR, CHECKING** .

   - In case of malfunction it is displayed as Throttle Position sensor -G69-

C. **Clutch vacuum vent valve switch -F36-**
   - in footwell on clutch pedal

NOTE: The following list refers to Fig. 1 .

1. **EGR valve**
2. **Change-over valve for intake manifold flap -N239-**
3. **Needle Lift Sensor -G80-**
4. **EGR vacuum regulator solenoid valve -N18-**
5. **Diesel Direct Fuel Injection (DFI) Engine Control Module (ECM) -J248-**

- with Barometric Pressure (BARO) sensor -F96-
- tighten nut for ground wire (located forward of ECM) to 9 +/- 1 Nm (80 +/- 9 in. lb)

6. **Wastegate bypass regulator valve -N75-**
7. **Mass Air Flow (MAF) Sensor -G70-**
8. **Engine Coolant Temperature (ECT) Sensor -G62-**
9. **Engine speed (RPM) sensor -G28-**
10. **Harness connector**
    - for Needle lift sensor -G80-
11. **Harness connector**
    - for Engine Speed sensor -G28-
    - for Cold Start injector -N108-
12. **Harness connector**
    - for Fuel temperature sensor -G81-
    - for Quantity adjuster -N146-
    - for Modulating piston displacement sensor -G149-
    - for Fuel shut-off valve -N109-
13. **Cold start injector -N108-**
14. **Fuel shut-off valve -N109-**
15. **Injection pump Quantity adjuster -N146-**
    - with Fuel temperature sensor
    - with Quantity adjuster -N146-
    - with Modulating piston displacement sensor -G149-
16. **Manifold Absolute Pressure (MAP) sensor -G71- and Intake Air Temperature (IAT) sensor -G72-**

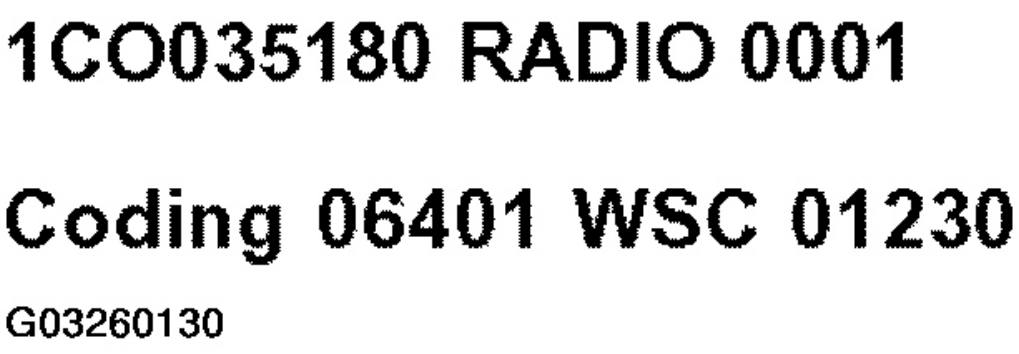


Fig. 1: Identifying Diesel Injection System Component Locations (1.9L ALH)

Courtesy of VOLKSWAGEN OF AMERICA, INC.

Diesel injection pump, servicing

- Observe Rules of cleanliness. See **RULES FOR CLEANLINESS** .
- Removing and installing Diesel injection pump. See **DIESEL INJECTION PUMP, REMOVING AND INSTALLING** .
- Dynamically checking and adjusting Diesel injection pump. See **START OF INJECTION, DYNAMICALLY CHECKING AND ADJUSTING** .

NOTE: The following list refers to Fig. 2 .

1. **20 Nm (15 ft lb) + 1/4 turn (90 °) further**
   - Always replace
2. **Injection pump sprocket**
   - Removing. See **DIESEL INJECTION PUMP, REMOVING AND INSTALLING** .
3. **Nut**
   - for hub

   CAUTION: Do not loosen nut or basic setting of pump may change. This cannot be reset using normal workshop equipment.

4. **Union**
   - 25 Nm (18 ft lb)
   - for supply line
   - from fuel filter
5. **Diesel injection pump**
   - with Quantity adjuster (metering)
   - with Quantity adjuster -N146-
   - with Modulating piston displacement sensor -G149-
   - with Fuel temperature sensor
6. **Fuel shut off valve**
   - 40 Nm (30 ft lb)
7. **Union**
   - for return line
8. **Return line**
   - to control valve/fuel filter
9. **25 Nm (18 ft lb)**
10. **Fuel injector lines**

- 25 Nm (18 ft lb)
  - Remove with 3035
  - Always remove fuel line cluster as an assembly
  - Do not bend, kink or alter shape

11. **Union**
    - 45 Nm (33 ft lb)
    - with pressure valve
12. **25 Nm (18 ft lb)**
13. **3rd cylinder Fuel injector**
    - includes Needle lift sensor -G80-
    - Removing and installing. See **FUEL INJECTORS, REMOVING AND INSTALLING** .
    - Servicing. See **FUEL INJECTORS, SERVICING** .
14. **20 Nm (15 ft lb)**
15. **Retainer**
16. **Mounting**
17. **Heat shield**
    - Always replace
18. **10 Nm (7 ft lb)**
19. **Cold Start injector -N108-**
    - Checking. See **FUNCTION 03: OUTPUT DIAGNOSTIC TEST MODE, PERFORMING** .
20. **Strainer**
21. **O-ring**
    - Always replace
22. **25 Nm (18 ft lb)**
23. **Timing cover**
    - Replace O-ring if leaking. See **DIESEL INJECTION PUMP TIMING COVER O-RING, REPLACING** .
24. **Sleeve**
    - with nut
25. **Assembly bracket**
    - Removing and installing. See **ENGINE, DISASSEMBLING AND ASSEMBLING** .
26. **25 Nm (18 ft lb)**

Fig. 2: Identifying Diesel Injection Pump Components (1.9L ALH)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Intake manifold change-over valve, servicing

The intake manifold change-over flap is closed for approx. 3 seconds when engine stops and then opens again which reduces the stop jolt.

Intake manifold change-over valve, checking. See **CHANGE-OVER VALVE FOR INTAKE MANIFOLD FLAP -N239-, CHECKING** .

NOTE: The following list refers to Fig. 3 .

1. **Intake manifold**
2. **10 Nm (7 ft lb)**
3. **O-ring**
   - Always replace
4. **Connecting flange**
   - with EGR valve and change-over flap
5. **10 Nm (7 ft lb)**
6. **Gasket**
   - Always replace
7. **Connecting line**
   - to exhaust manifold
8. **25 Nm (18 ft lb)**

9. **Vacuum control element**
10. **Intake Manifold Flap Change-over valve -N239-**
    - Checking. See **CHANGE-OVER VALVE FOR INTAKE MANIFOLD FLAP -N239-, CHECKING** .
11. **Vacuum supply**
    - from vacuum pump

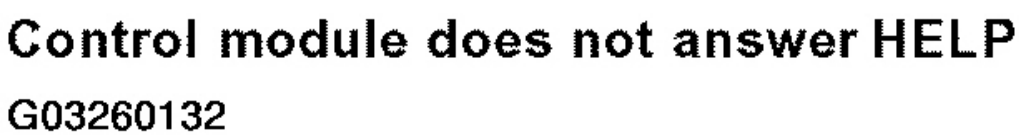


Fig. 3: Identifying Intake Manifold Change-Over Valve Components
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Diesel injection pump, removing and installing

Special tools

- 3098 Lever camber adjustment
- V159 Pin wrench
- 3359 Rig pin
- VAG1318/10 Adapter
- 3418 Adjustment guide
- VAG1390 Hand vacuum pump

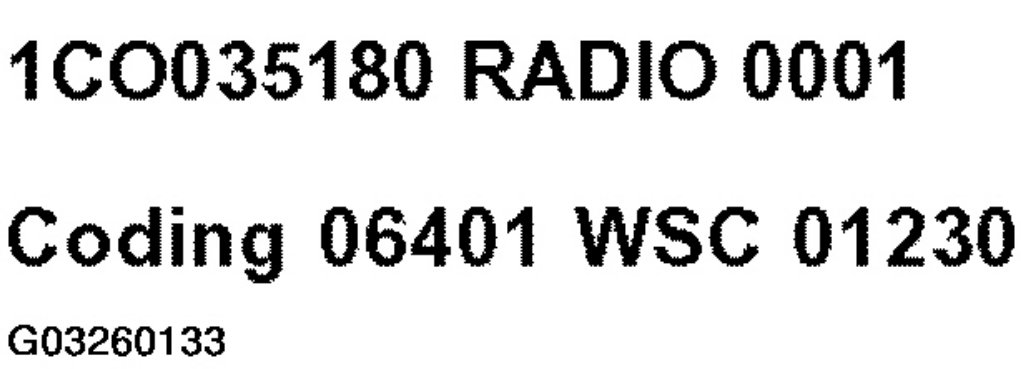


Fig. 4: Identifying Special Tools For Removing & Installing Diesel Injection Pump (1 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Special tools, continued

- 2068A Adj. gauge TDC
- 3035 Injector line wrench
- VAG1331 Torque wrench 5 to 50 Nm (3.7 to 37 ft lb) or equivalent

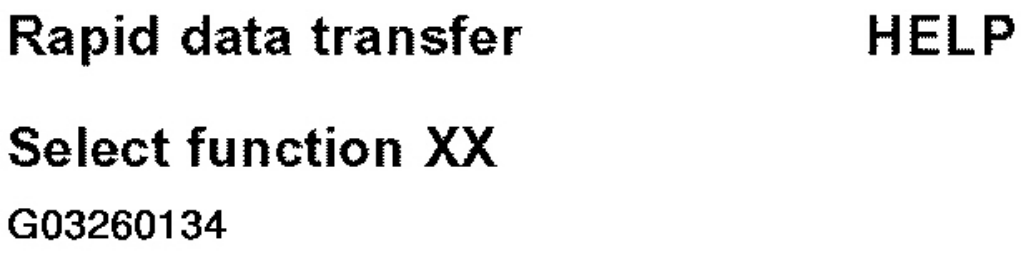


Fig. 5: Identifying Special Tools For Removing & Installing Diesel Injection Pump (2 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Diesel injection pump, removing

WARNING: Fire hazard! Do NOT have anything in the area that can ignite Diesel fuel.

- Unbolt all fuel lines at fuel pump.

NOTE: Use 3035 tubing wrench to loosen the high pressure fuel lines.

- Cover openings with a clean cloth.
- Remove connecting line between charge air cooler and intake manifold.
- Remove upper toothed belt guard and valve cover.
- Remove vacuum pump for brake servo.
- Turn crankshaft to cyl. 1 TDC (arrow).

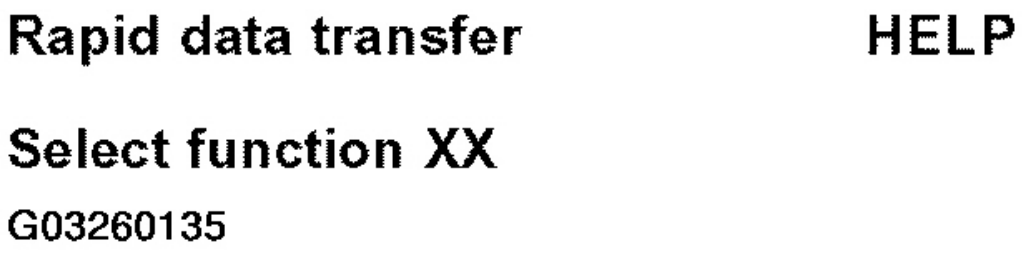


Fig. 6: Turning Crankshaft To Cyl. 1 TDC (Manual Transmission)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Turn crankshaft to cyl. 1 TDC (arrow)

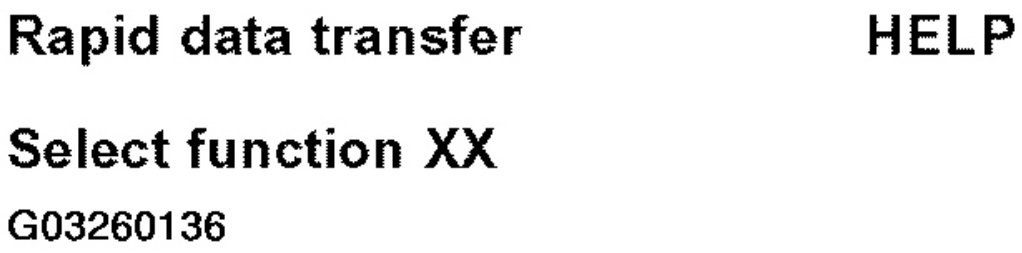


Fig. 7: Turning Crankshaft To Cyl. 1 TDC (Automatic Transmission)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- for Automatic transmission

With engine removed

Vehicles with manual transmission

- Install 2068 A TDC gauge as shown.
- Set adjustment device to 96 mm (arrow -A-).
  - Left-hand notch of the vernier scale is the reference point.
- Turn crankshaft until flywheel TDC marking aligns with point of setting device (arrow -B-).

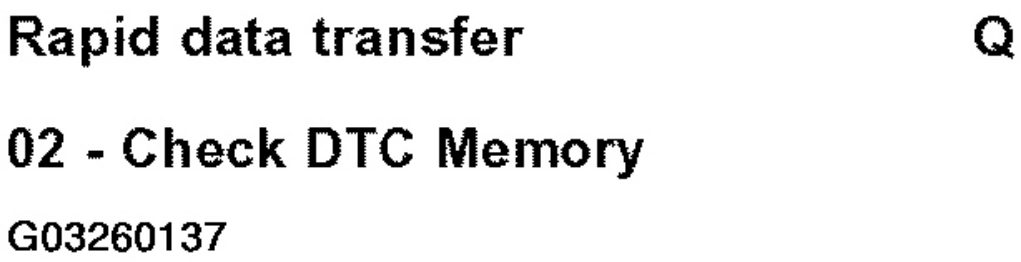


Fig. 8: Setting Adjustment Device & Turning Crankshaft Until Flywheel TDC Marking Aligns With Setting Device (Manual Transmission)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Vehicles with automatic transmission

- Install 2068 A TDC gauge as shown.
- Set adjustment device to 30 mm (arrow -A-).
  - Left-hand notch of the vernier scale is the reference point.
- Turn crankshaft until TDC marking on drive plate aligns with point of setting device (arrow -B-).

Fig. 9: Setting Adjustment Device & Turning Crankshaft Until Flywheel TDC Marking Aligns With Setting Device (Automatic Transmission)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

All vehicles

- Lock camshaft with setting bar.

Fig. 10: Locking Camshaft With Setting Bar 3418
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Centralize setting bar as follows:

Turn camshaft so that one end of setting bar contacts the cylinder head. Using feeler gauge, establish the gap at the other end of the setting bar. Place a feeler gauge corresponding to half the gap between setting bar and cylinder head. Turn camshaft until the setting bar contacts the feeler gauge. Place a 2nd feeler gauge, of same thickness, at the other end between the setting bar and cylinder head.

- Remove injection pump sprocket mounting bolts -1-.

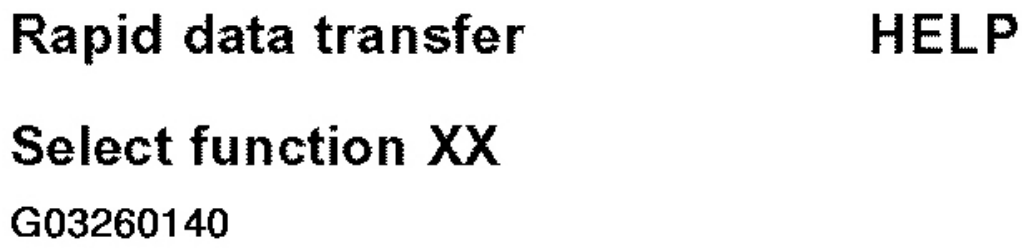


Fig. 11: Removing Injection Pump Sprocket Mounting Bolts & Hub Nut
Courtesy of VOLKSWAGEN OF AMERICA, INC.

CAUTION: Do not loosen hub nut -2- for ANY reason. Otherwise, the Diesel injection pump basic setting will be altered and cannot be reset with normal workshop equipment.

- Remove tensioning roller nut.
- Relieve tooth belt tension then remove camshaft and injection pump sprockets.
- Disconnect Quantity adjuster harness connector and unclip connector from retainer.
- Remove mounting bolts from assembly bracket -1-.

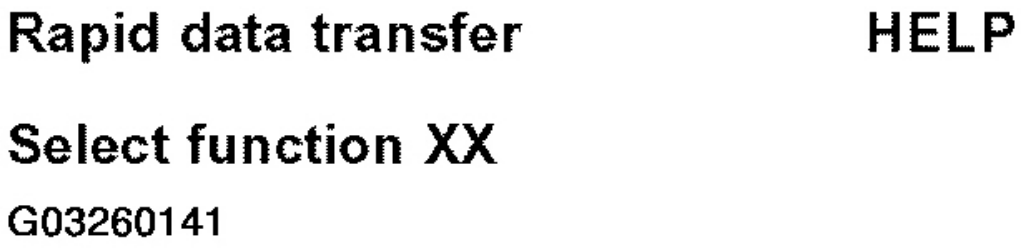


Fig. 12: Removing Mounting Bolts From Assembly Bracket
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove bolt from rear support (arrow).

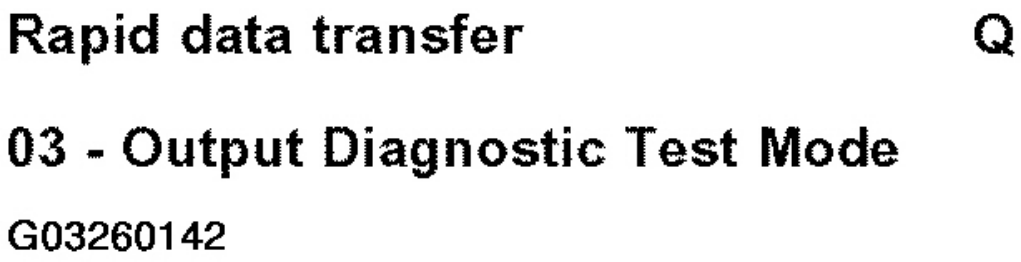


Fig. 13: Removing Bolt From Rear Support
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove Diesel injection pump.

Diesel injection pump, installing

- Insert injection pump into assembly bracket then tighten mounting bolt on rear support with conical nut first.
- Insert front mounting bolts.
- tighten to 25 Nm (18 ft lb)
- Install new bolts (arrows) to mount injection pump sprocket to hub but do not tighten.

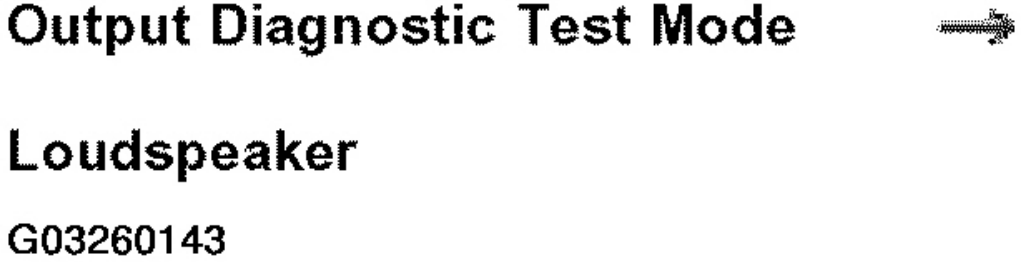


Fig. 14: Installing New Bolts To Mount Injection Pump Sprocket To Hub
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Align injection pump sprocket to central position in elongated holes.

- Lock injection pump sprocket using 3359 pin.
- Loosen camshaft sprocket mounting bolt a half turn.
- Place a drift through hole in rear of toothed belt guard and release camshaft sprocket from camshaft taper with blow from hammer.

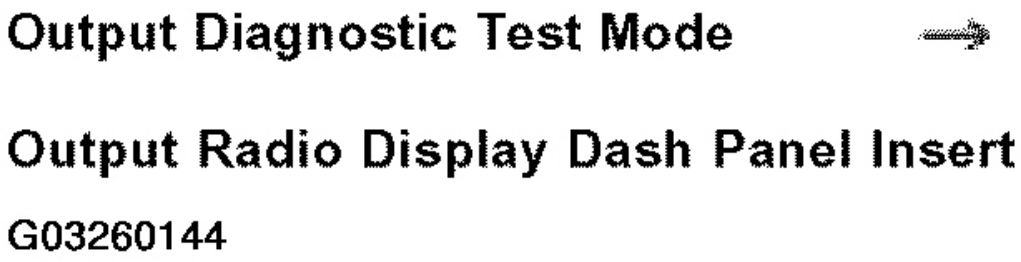


Fig. 15: Placing Drift Through Hole In Rear Of Toothed Belt Guard & Releasing Camshaft Sprocket Using Hammer
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove camshaft sprocket.
- Check whether TDC mark on flywheel and reference mark are aligned.
- Place tooth belt on injection pump sprocket and tensioning roller.
- Install camshaft sprocket into toothed belt and secure sprocket such that the camshaft can still turn.
- Tension toothed belt using pin wrench (e.g. Matra V159) on eccentric and turning clockwise until notch and raised mark align (arrows).

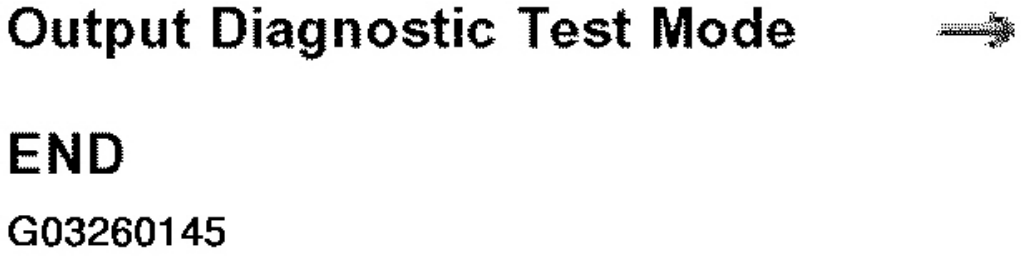


Fig. 16: Tensioning Toothed Belt Using Pin Wrench & Aligning Notch & Raised Mark
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: **Make sure retaining hook is correctly seated in toothed belt guard.**

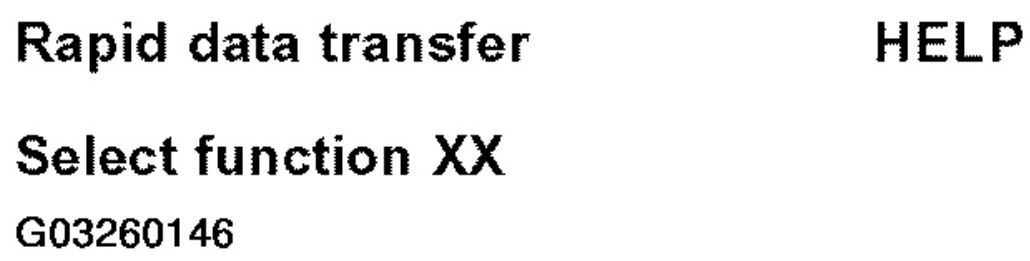


Fig. 17: Ensuring Retaining Hook Is Correctly Seated In Toothed Belt Guard
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Tighten mounting nut.
  - 20 Nm (15 ft lb)
- Check TDC mark on flywheel again.
- Tighten new mounting bolts for injection pump sprocket.
  - 20 Nm (15 ft lb)

NOTE:

- **After dynamically checking the injection timing, tighten the bolts an additional 1/4 turn (90 °).**
- **The mounting bolts (stretch design) may only be used once.**

- Tighten camshaft sprocket mounting bolt.
  - 45 Nm (33 ft lb)

- Remove 3359 locking pin.
- Remove 3418 setting bar from camshaft.
- Turn crankshaft two rotations in direction of engine rotation until crankshaft is set to cyl. 1 TDC again.
- Reconnect injection lines, fuel supply line and electrical wiring.

Fill injection pump with Diesel fuel as follows.

- Screw 1318/10 adapter into injection pump return/supply opening.
- Connect VAG1390 hand vacuum pump to adapter using approx. 40 inches of transparent plastic hose.

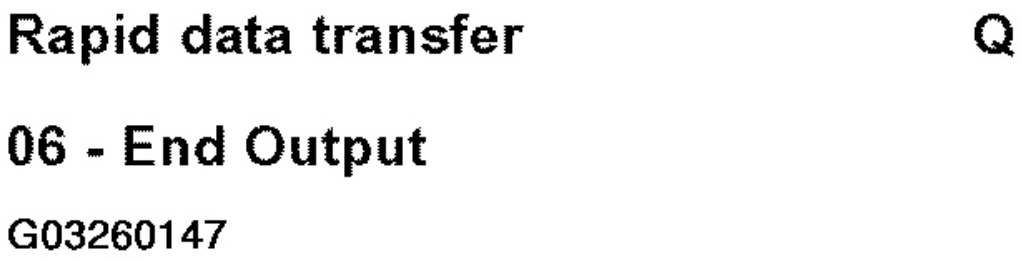


Fig. 18: Connecting VAG1390 Hand Vacuum Pump To Injection Pump
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Operate vacuum pump until fuel flows out of return/supply opening.
  - Do not draw fuel into vacuum pump.
- Remove adapter and connect return/supply line.
- Install valve cover and vacuum pump.
- Dynamically check Start of injection and adjust if necessary. See **START OF INJECTION, DYNAMICALLY CHECKING AND ADJUSTING** .

Start of injection, dynamically checking and adjusting

Special tools

- VAG1331 Torque wrench 5 to 50 Nm (3.7 to 37 ft lb) or equivalent

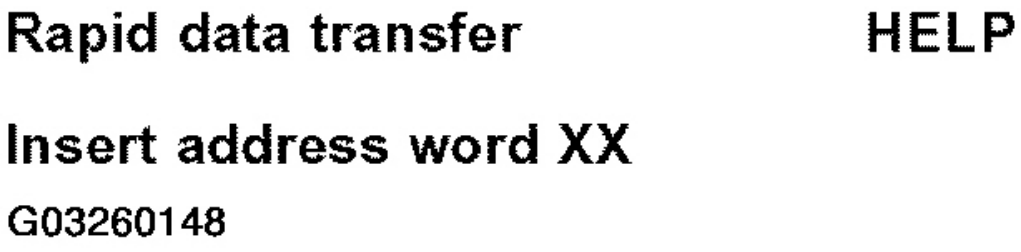


Fig. 19: Identifying Special Tool VAG 1331
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- VAG1551/1552 Scan Tool using VAG1551/3 Adapter cable
- 3035 Injection line wrench

NOTE:

- **Dynamically checking and correcting Start of injection is only possible in Function 04, "Basic setting".**
- **Start of injection must always be checked after replacing the toothed belt or loosening the injection pump bolts or toothed belt sprockets and if necessary, adjusted.**

Checking and adjustment conditions

- Mechanical engine settings OK.
- Toothed belt tension OK.

Work sequence

- Connect VAG1551/1552 Scan Tool. See **VAG1551/1552 SCAN TOOL, CONNECTING** .
- Start engine and let idle.
- Press -0- and -1- buttons to select Address word 01: "Engine electronics"

  Display will appear as shown (example only)

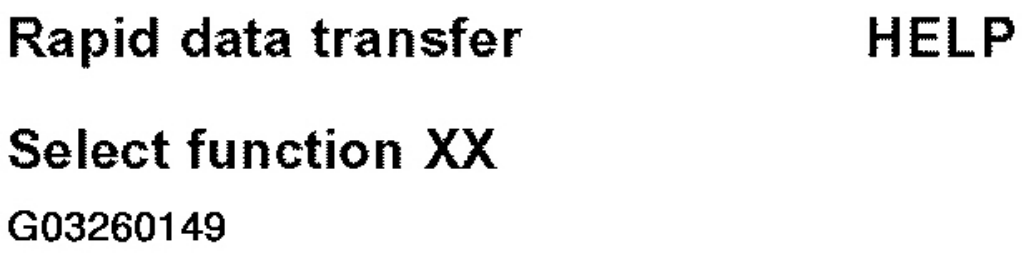


Fig. 20: Scan Tool Display - Start Of Injection (1 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press --> button.

Display will appear as shown

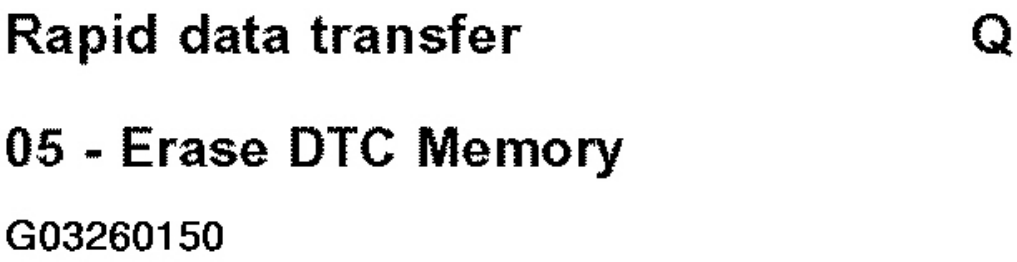


Fig. 21: Scan Tool Display - Start Of Injection (2 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -4- buttons to select Function 04: "Basic setting"
- Press -Q- button to enter input.

Display will appear as shown

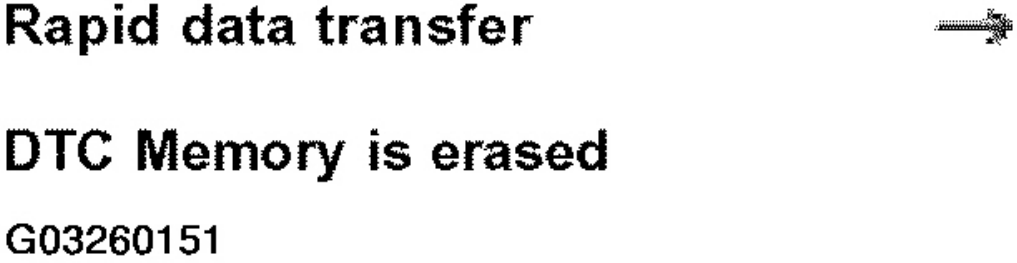


Fig. 22: Scan Tool Display - Start Of Injection (3 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0-, -0-, -0- button to select "Display group 0".
- Press -Q- button to enter input.

Display will appear as shown (1 to 10 = Display zones)

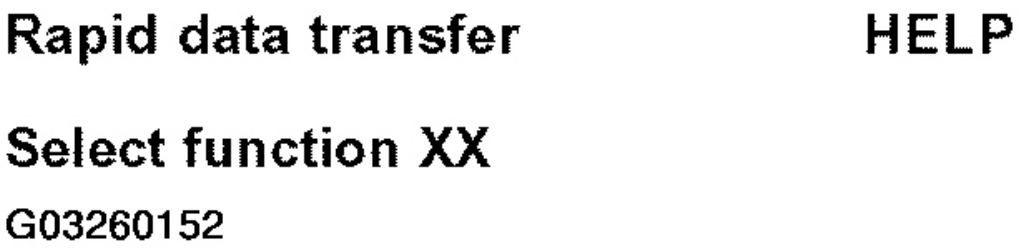


Fig. 23: Scan Tool Display - Start Of Injection (4 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check Engine Coolant Temperature in Display zone 7.
- Specification: less than 73 (equates to 85 °C)

Continue check only when Engine Coolant Temperature is obtained:.

Start of injection (in Display zone 2) is dependent on the Fuel temperature in Display zone 9.

A. Display zone 2 Start of injection
B. Display zone 9 Fuel temperature
C. Specified range for Start of injection

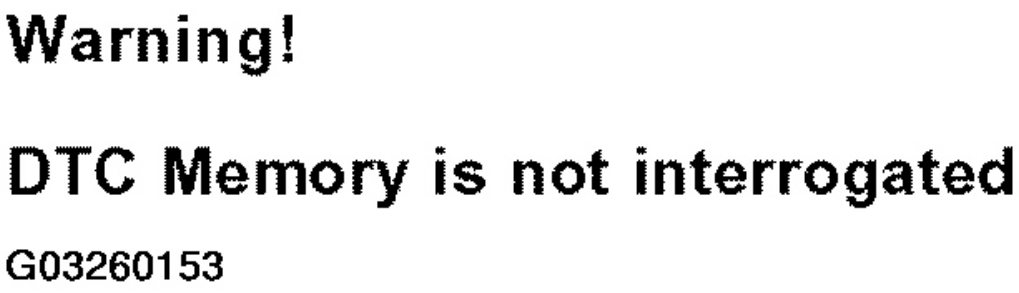


Fig. 24: Specification Range For Start Of Injection Graph
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Example:

Value 90 in Display zone 9 (B) corresponds to a numerical range from 35 to 74 in Display zone 2 (A).

NOTE: If, when checking Start of injection, the specifications are within zone -C-, no adjustment is required. After repairs, e.g. removing and installing injection pump or adjusting timing, Start of injection must be set to the mean value (dashed line) in zone -C-.

If Start of injection is outside specification, adjust as follows:

- Remove connecting line between charge air cooler and intake manifold.
- Remove upper toothed belt guard.
- Loosen two injection pump sprocket mounting bolts -1-.

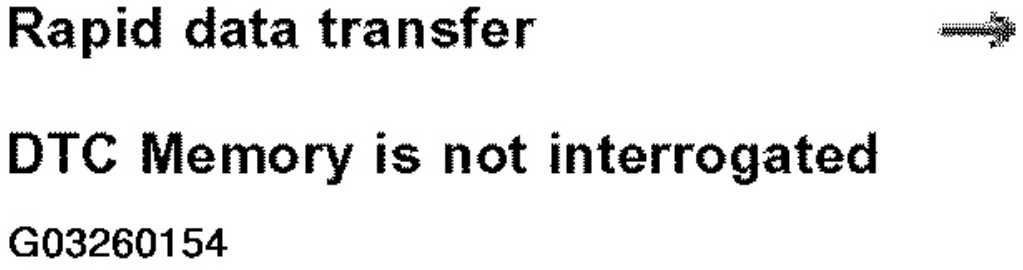


Fig. 25: Locating Injection Pump Sprocket Mounting Bolts & Hub Nut
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Place 22 mm box wrench onto hub nut -2- to counter-hold pump shaft. DO NOT loosen hub nut.
- Loosen 3rd injection pump sprocket mounting bolt and slightly turn pump shaft
- Left = advance Start of injection
- Right = retard Start of injection

CAUTION: Do not loosen hub nut -2- for ANY reason. Otherwise, the Diesel injection pump basic setting will be altered and cannot be reset with normal workshop equipment.

- Tighten new mounting bolts for injection pump sprocket.
  - 20 Nm (15 ft lb)

If injection pump has not previously been removed and installed

- Screw in new injection pump sprocket mounting bolts one after the other.
- Observe values in zone 2 and adjust again, if necessary, until the mean value for specification zone -C- is displayed.
- Tighten injection pump sprockets 1/ 4 turn (90 °) additional.
- Press --> button.

Display will appear as shown:

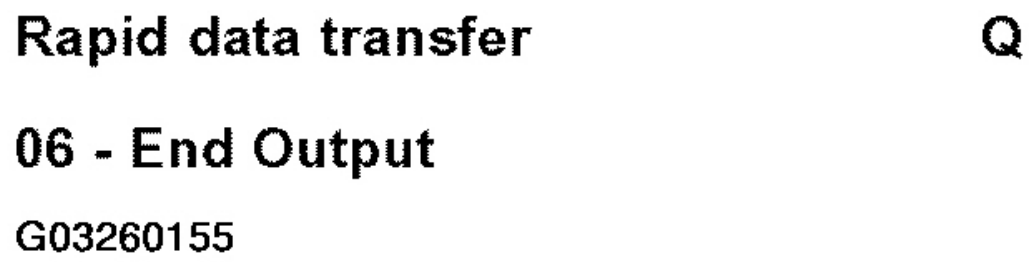


Fig. 26: Scan Tool Display - Start Of Injection (5 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -6- buttons to select Function 06: "End output".
- Press -Q- button to enter input.
- Erase DTC memory. See **DTC MEMORY, ERASING** . Set the readiness code. See **READINESS CODE, SETTING** .

Fuel injectors, removing and installing

Special tools

- VAG1331 Torque wrench (5 to 50 Nm) or equivalent

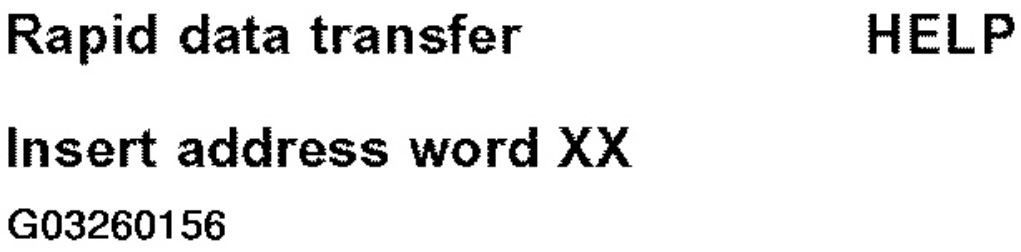


Fig. 27: Identifying VAG 1331 Torque Wrench
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- 3035 Injector line wrench

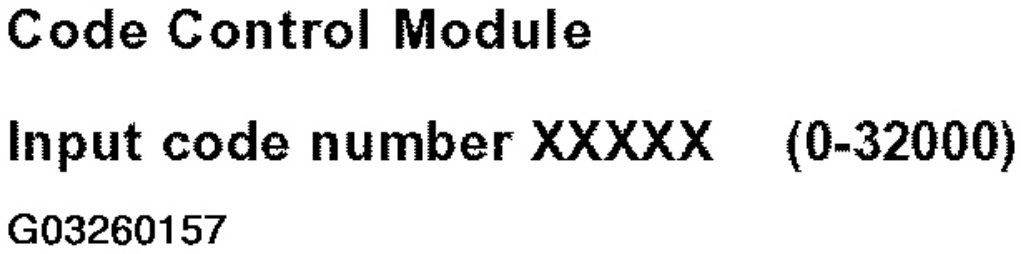


Fig. 28: Identifying 3035 Injector Line Wrench
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Faulty injectors can cause the following malfunctions:

- **Misfiring**
- **Knocking in one or more cylinders**
- **Engine over-heating**
- **Loss of power**
- **Excessive black exhaust smoke**
- **Higher fuel consumption**
- **Excessive blue smoke when starting with cold engine**

NOTE: Faulty injectors can be located by loosening the high pressure line connection on each injector in turn with the engine running at a fast idle. If engine speed remains constant after loosening a line connection, this would indicate a faulty injector.

Fuel Injectors, removing

- Remove injection lines using 3035 tubing wrench.

NOTE: Always remove fuel lines in a complete set. Do not alter line shape.

- Remove mounting nut, retainer and pull out fuel injector.

Fuel injectors, installing

NOTE: Always replace heat shield between cylinder head and fuel injectors.

- Insert fuel injector.
- Make sure mount is seated correctly in cylinder head and install retainer.

Tightening torques:

- Injection lines = 25 Nm (18 ft lb)
- Retainer screw = 20 Nm (15 ft lb)

- Erase DTC memory. See **DTC MEMORY, ERASING** . Set the readiness code. See **READINESS CODE, SETTING** .

Fuel injectors, servicing

The AHL engine is equipped with dual spring design injectors. Fuel is injected in 2 stages. These fuel injectors must be replaced if malfunctions occur because neither servicing nor pressure adjustment is possible.

Special tools

- VAG1322 Injector test stand with VAG1322/2 pressure line

Checking requirements

- Pressure gauge on

Fuel injection pressure, checking

WARNING: When testing fuel injectors, make sure that the stream of fuel does not contact your hands. The high pressure fuel delivery can penetrate skin

which could result in severe injuries.

- Connect fuel injector to fuel injector test stand.

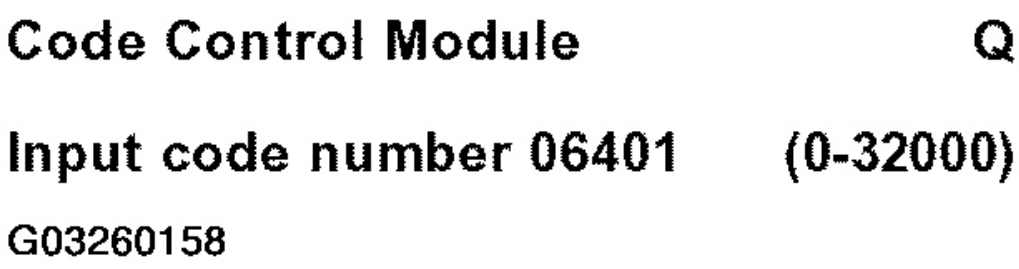


Fig. 29: Connecting Fuel Injector To Fuel Injector Test Stand
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Move pump lever down slowly. When spray begins, record opening pressure for deviations from specification replace injector.
- Specification (new injectors): 220 - 230 bar
- Wear limit: 200 bar

Fuel injectors, leak-checking

- Pressure gauge on
- Move pump lever down slowly and maintain a pressure of approx. 150 bar for 10 seconds.
- No fuel should leak from the nozzle tip.
- If any injector(s) leak, replace.

Diesel injection pump timing cover O-ring, replacing

- Place a clean cloth under the Diesel injection pump.
- Remove cover screws -1- with commercially available tool for Torx socket head screws, e.g. Hazet 2115 -T30.
- Remove cover -2- and clean thoroughly.
- Replace O-ring -3- and install cover using existing shims -4-.

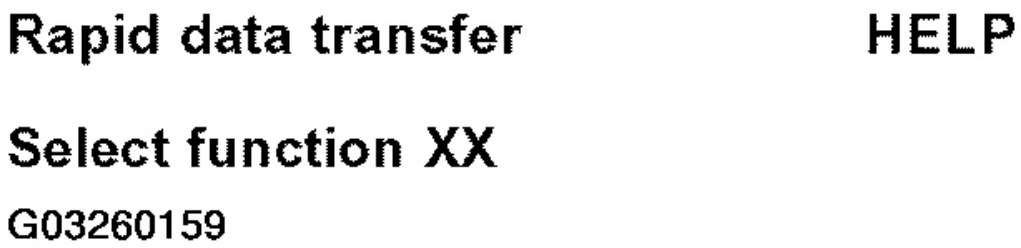


Fig. 30: Removing Injection Pump Timing Cover Assembly
Courtesy of VOLKSWAGEN OF AMERICA, INC.

DIESEL FUEL INJECTION COMPONENTS AND FUNCTIONS, CHECKING

WARNING: Make sure that no electronic components are destroyed during testing by observing the following:

- **Switch the Fluke 83 multimeter to the appropriate units range before connecting measuring cables!**
- **Always observe checking requirements!**

NOTE:

- **Use the Fluke 83 multimeter and VAG1527B Voltage tester for electrical checking.**
- **Specifications are valid for an ambient temperature range from: 0 to + 40 ° C (+32 to 104 °F).**
- **If measured values deviate only slightly from the specifications, clean the sockets and plugs on the tester and measuring cables, then repeat check. Before replacing a component, check wiring and connections. In cases of specifications less than 10 ohm repeat the resistance measurement on the component.**
- **To connect a tester to the Test Box, use jumper wires from the VW 1594 adapter kit.**
- **The terminal numbers of the plugs and the socket numbers on the Test Box are identical.**

Diesel injection system Voltage supply, checking

Special tools

- VAG1598/22 Test Box (MY 1999)

- VAG1598/31 Test Box (from MY 2000)
- Fluke 83 multimeter
- VW 1594 Adapter kit
- Wiring diagram

Test requirements

- Battery Voltage OK.

Test sequence

- Switch OFF ignition.
- Connect VAG1598/22 (or 1598/31) Test Box to ECM wiring harness.

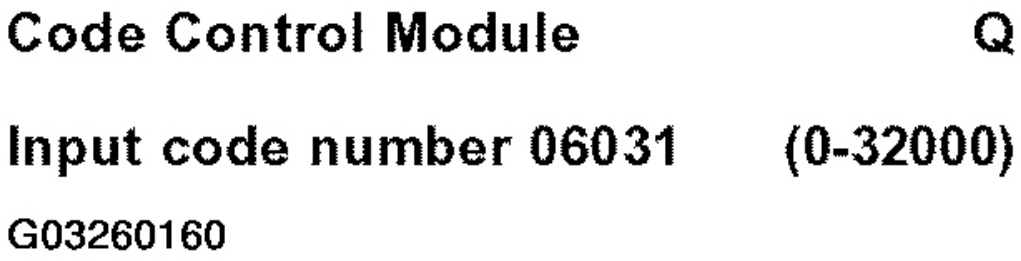


Fig. 31: Connecting VAG1598/22 Test Box To ECM Wiring Harness
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Bridge sockets with jumper wires from VW 1594 kit.
- Up to MY 1999: sockets 33 + 1
- From 2000: sockets 18 + 4
- Measure Voltage between following sockets:
- Up to MY 1999: sockets 2 + 1, 28 + 1, 27 + 2 and 28 + 27
- From 2000: sockets 1 + 4, 2 + 4, 1 + 5, 2 + 5
- Specification: approx. battery Voltage

If specification not obtained:

- Check power supply relay -J31-, terminal 30.

- -J317- located on fuse relay panel above the central electric.
- Check wiring for open circuit, short circuit and transfer resistance at terminals using Wiring diagram.

If wiring and relay OK:

- Replace Engine Control Module -J248-. See **Engine Control Module (ECM), replacing** .

Engine speed (RPM) sensor -G28-, checking

Engine speed (RPM) sensor -G28- serves dual purpose of speed and reference mark sensor. An inoperative sensor will stop engine.

Special tools

- VAG1598/22 Test Box (MY 1999)
- VAG1598/31 Test Box (from MY 2000)
- Fluke 83 multimeter
- VW 1594 Adapter kit
- Wiring diagram

Test sequence

- Switch OFF ignition.
- Disconnect -G28- harness connector. See **DIESEL INJECTION SYSTEM, COMPONENT LOCATIONS OVERVIEW** .
- Measure resistance between connector terminals 1 + 2.
  - Specification: 1000 to 1500 ohm

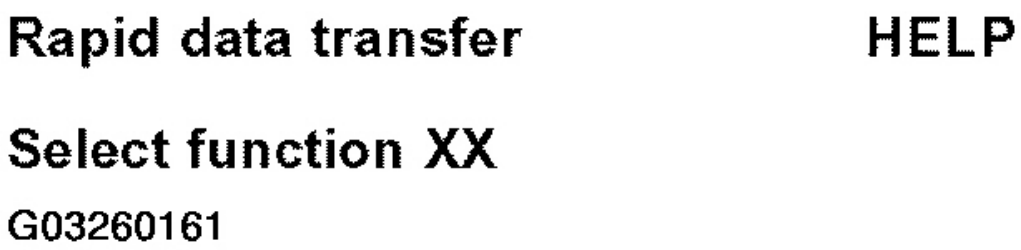


Fig. 32: Identifying Engine RPM Sensor Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

If specification not obtained:

- Replace Engine Speed sensor -G28-.

See **ENGINE, DISASSEMBLING AND ASSEMBLING** .

- Display the Readiness code. See **READINESS CODE, DISPLAYING** .

If DTC memory was erased:

- Set the readiness code. See **READINESS CODE, SETTING** .

If specification obtained:

- Connect VAG1598/22 (or 1598/31) Test Box to ECM wiring harness.

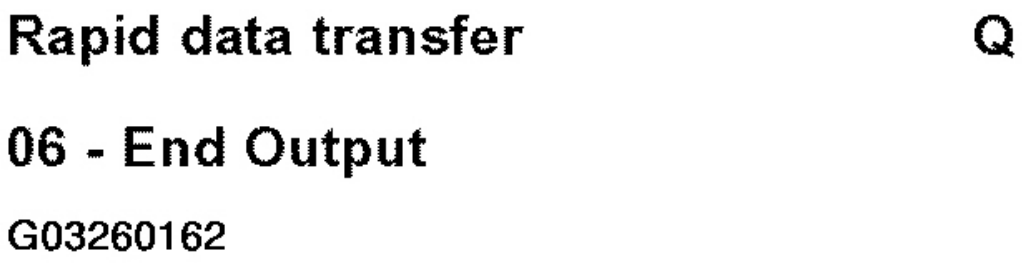


Fig. 33: Connecting VAG1598/22 (Or 1598/31) Test Box To ECM Wiring Harness
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check wiring for open circuit between Test Box and 3-pin harness connector using Wiring diagram.

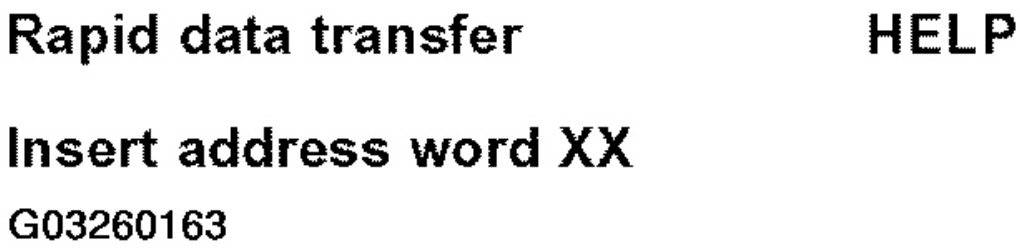


Fig. 34: Identifying Engine RPM Sensor Harness Connector Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Up to MY 1999

- Terminal 1 + socket 69
- Terminal 2 + socket 67
- Terminal 3 + socket 71

From MY 2000

- Terminal 1 + socket 102
- Terminal 2 + socket 110
- Terminal 3 + socket 86

- Wire resistance: 1.5ohm maximum

- Check wiring for short circuit to one another at 3-pin harness connector using Wiring diagram.

- Specification: INFINITY ohm

If wiring OK:

- Replace Engine Control Module -J248-. See **Engine Control Module (ECM), replacing** .
- Display the Readiness code. See **READINESS CODE, DISPLAYING** .

If DTC memory was erased:

- Set the readiness code. See **READINESS CODE, SETTING** .

Manifold Absolute Pressure (MAP) Sensor -G71- and Barometric Pressure (BARO) Sensor -F96-, checking

The BARO -F96- sensor is located in the Engine Control Module - Direct Injection System. The intake manifold pressure sensor is a separate component and is located in the pipe between the charge air cooler and intake manifold.

Special tools

- VAG1551/1552 Scan Tool using VAG1551/3 Adapter cable

Test sequence

- Connect VAG1551/1552 Scan Tool. See **VAG1551/1552 SCAN TOOL, CONNECTING** .
- Switch ON ignition but do not start engine.
- Press -0- and -1- buttons to select Address word 01: "Engine electronics"

Display will appear as shown (example only):

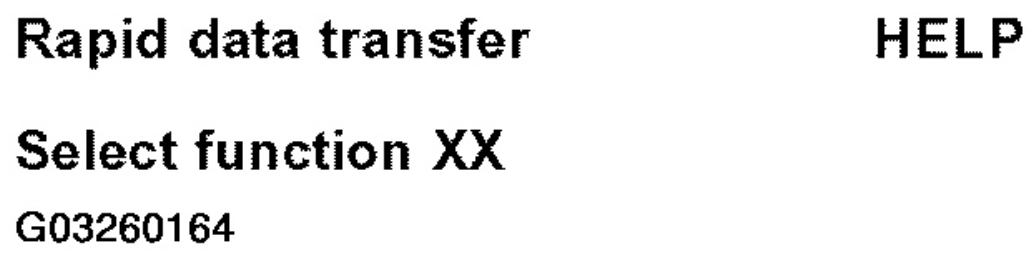


Fig. 35: Scan Tool Display - MAP Sensor & BARO Sensor (1 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press --> button.

Display will appear as shown:

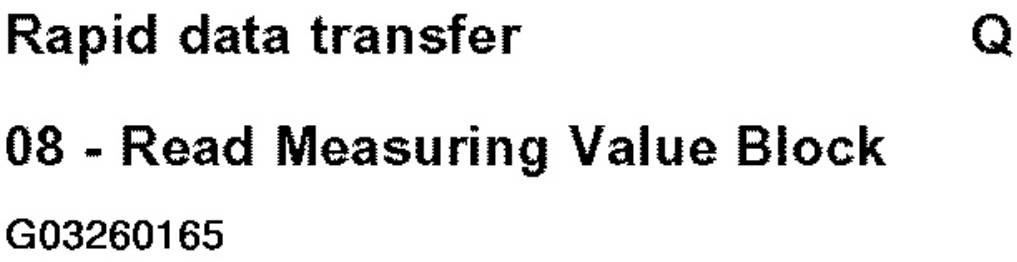


Fig. 36: Scan Tool Display - MAP Sensor & BARO Sensor (2 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -8- buttons to select Function 08: "Read measuring value block".
- Press -Q- button to enter input.

Display will appear as shown:

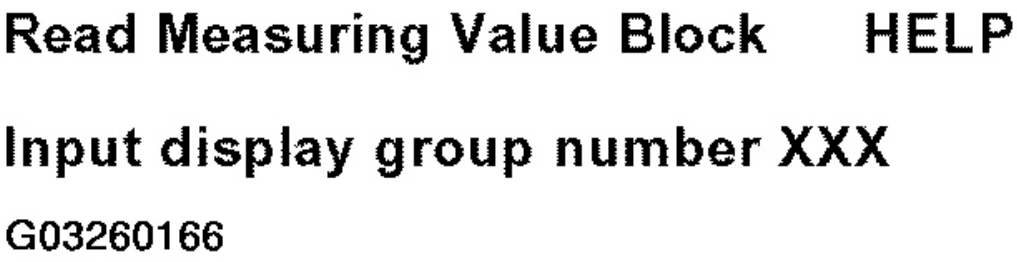


Fig. 37: Scan Tool Display - MAP Sensor & BARO Sensor (3 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0-, -1- and -0- buttons to select "Display group 10".

0 mg/H 1027 mbar 1013 mbar 0.0 %

Compare Display zone 2 (Barometric Pressure (BARO) Sensor -F96-) with Display zone 3 (Manifold Absolute Pressure (MAP) Sensor -G71-).

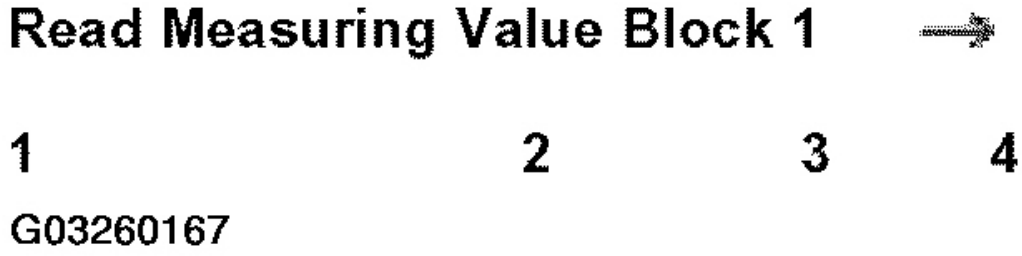


Fig. 38: Scan Tool Display - MAP Sensor & BARO Sensor (4 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Specification: pressures must be the same (+/-30 mbar)

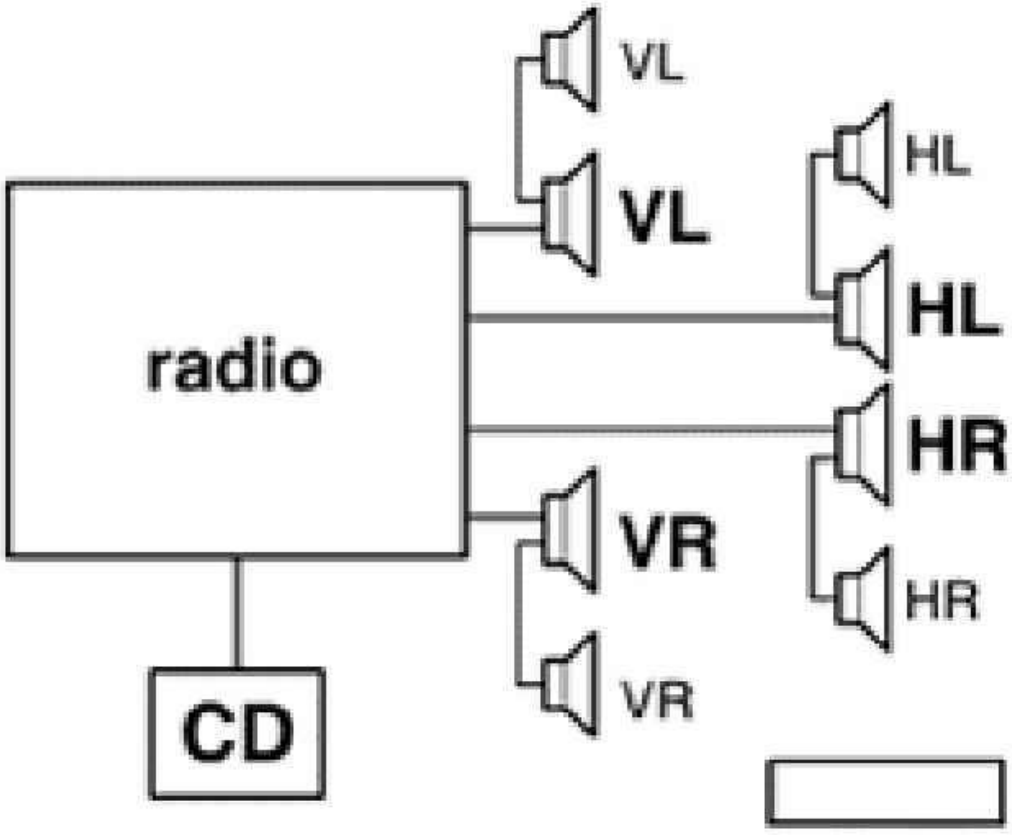
If value in Display zone 2 deviates:

- Replace Engine Control Module -J248-. See **Engine Control Module (ECM), replacing** .

If value in Display zone 3 deviates:

- Press --> button.

Display will appear as shown:



VL = Left front

HL = Left rear

VR = Right front

HR = Right rear

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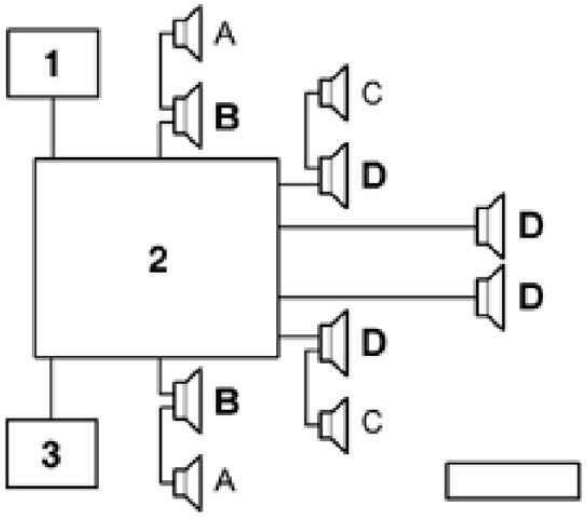
Fig. 39: Scan Tool Display - MAP Sensor & BARO Sensor (5 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -6- buttons to select Function 06: "End output".
- Press -Q- button to enter input.
- Switch OFF ignition.
- Connect VAG1598/22 (or 1598/31) Test Box to ECM wiring harness.



1 - Amplifier

2 - Radio Monsoon

3 - CD player

A - Domed treble loudspeaker in inner plenum chamber cover

B - Bass loudspeaker in inner plenum chamber cover

C - Domed treble loudspeaker in A-pillar trim

D - Bass loudspeaker, front and rear in side panel trim

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Fig. 40: Connecting VAG1598/22 (Or 1598/31) Test Box To ECM Wiring Harness
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Disconnect -G71- harness connector. See **DIESEL INJECTION SYSTEM, COMPONENT LOCATIONS OVERVIEW** .
- Check wiring for open circuit between Test Box and connector using Wiring diagram.

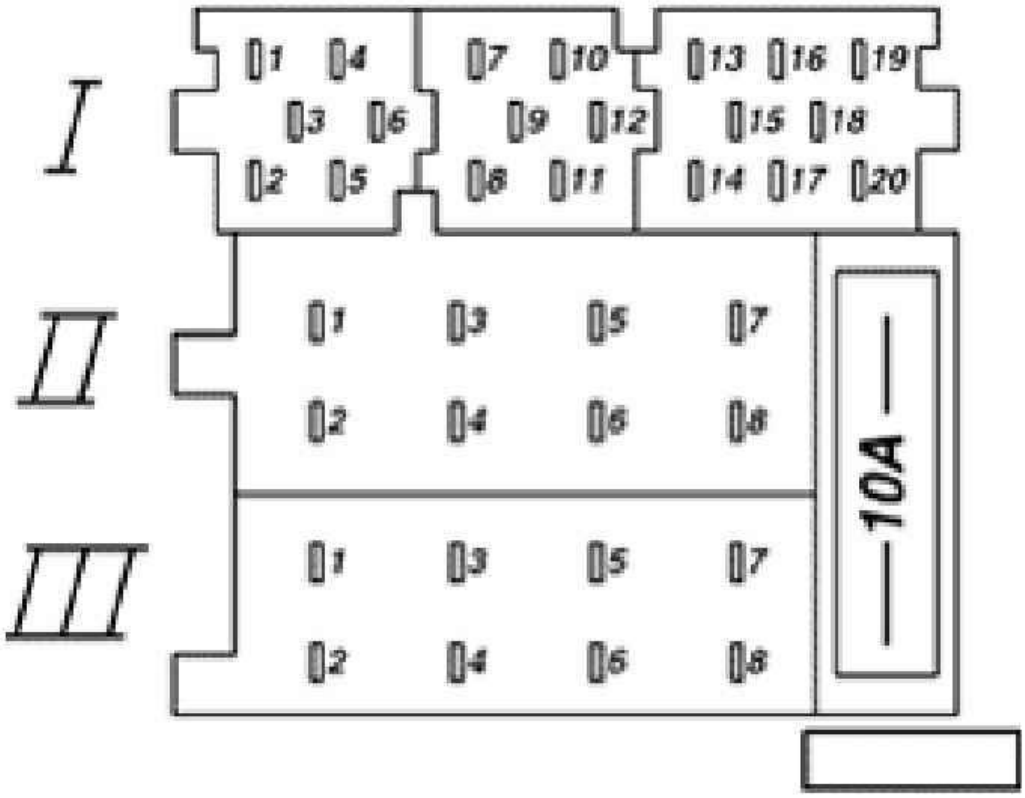

Fig. 41: Identifying MAP And BARO Sensor Harness Connector Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Up to MY 1999

- Terminal 3 + socket 39
- Terminal 4 + socket 40

From MY 2000

- Terminal 3 + socket 31
- Terminal 4 + socket 71

- Wire resistance: 1.5ohm maximum

- Check wires for short to one another, to Ground and to Battery +

- Specification: INFINITY ohm

If wiring OK:

- Replace Engine Control Module -J248-. See **Engine Control Module (ECM), replacing** .
- Display the Readiness code. See **READINESS CODE, DISPLAYING** .

If DTC memory was erased:

- Set the readiness code. See **READINESS CODE, SETTING** .

Engine Coolant Temperature (ECT) Sensor -G62-, checking

Special tools

- VAG1551/1552 Scan Tool or vehicle system tester VAG1552 using VAG1551/3 Adapter cable
- VAG1598/22 Test Box (MY 1999)
- VAG1598/31 Test Box (from MY 2000)
- Fluke 83 multimeter
- VW 1594 Adapter kit
- Wiring diagram

Test sequence

- Connect VAG1551/1552 Scan Tool. See **VAG1551/1552 SCAN TOOL, CONNECTING** .
- Start engine and let idle.
- Press -0- and -1- buttons to select Address word 01: "Engine electronics"

Display will appear as shown (example only):

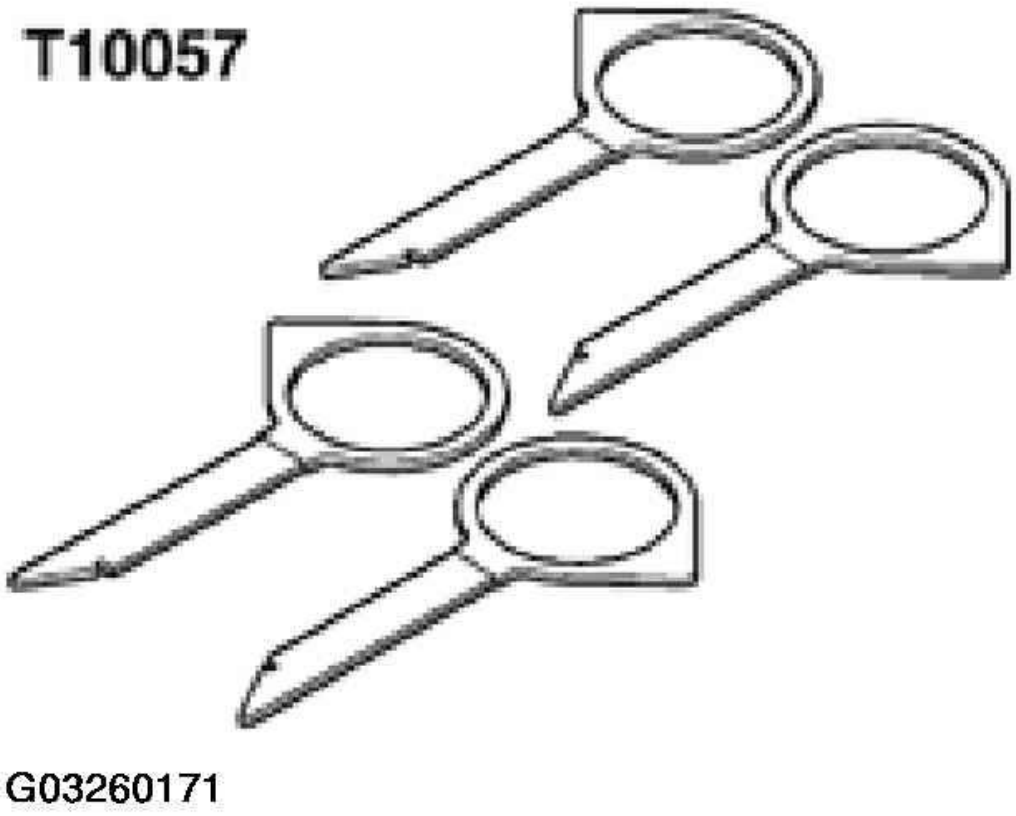

Fig. 42: Scan Tool Display - Engine Coolant Temperature Sensor (1 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press --> button.

  Display will appear as shown:

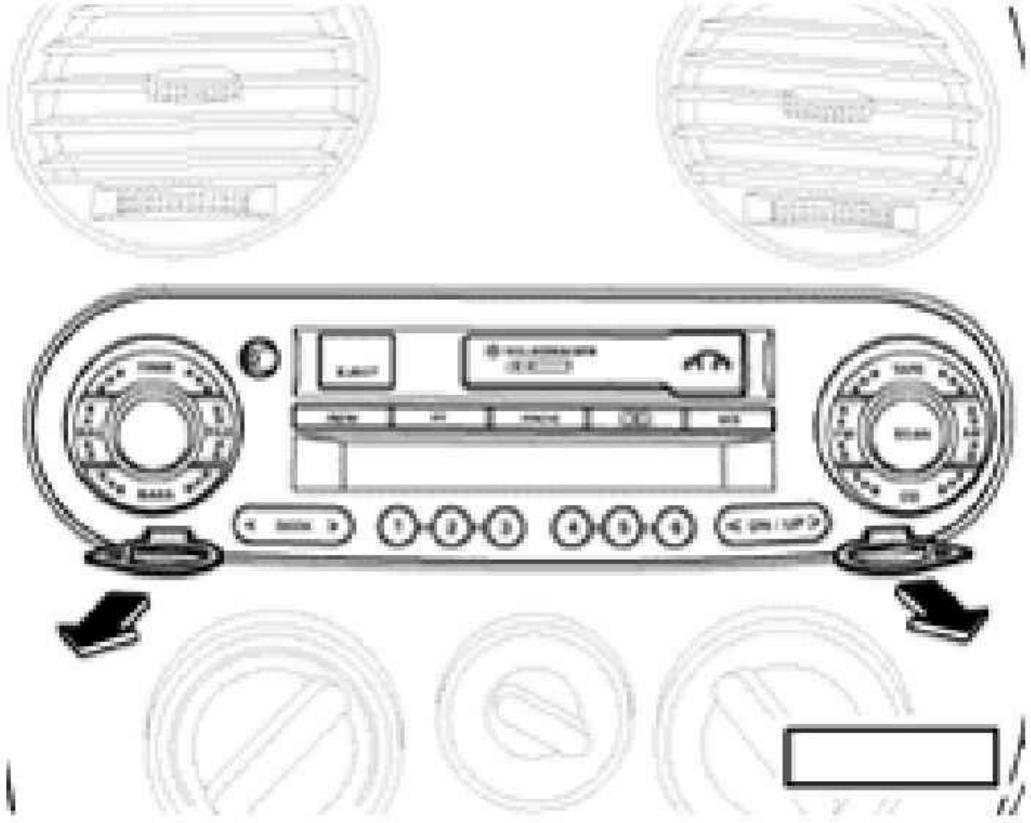

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Fig. 43: Scan Tool Display - Engine Coolant Temperature Sensor (2 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -8- buttons to select Function 08: "Read measuring value block".

Display will appear as shown:

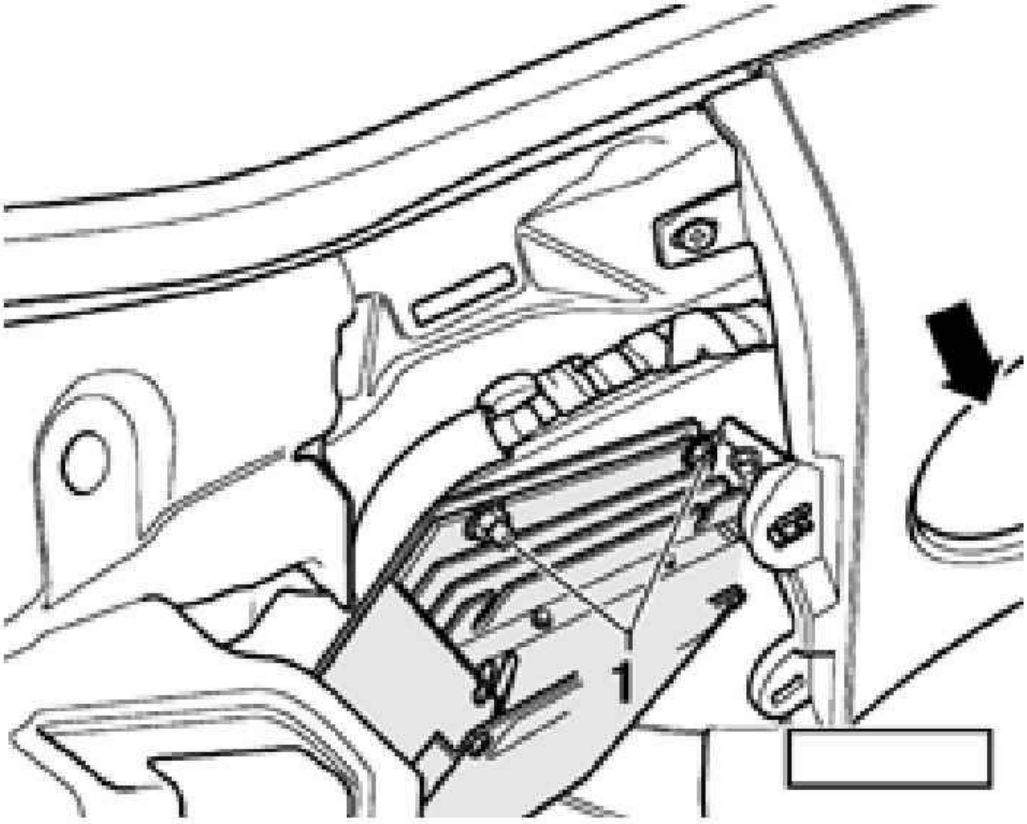


Fig. 44: Scan Tool Display - Engine Coolant Temperature Sensor (3 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0-, -0- and -7- buttons to select "Display group 7".
- Display will appear as shown:

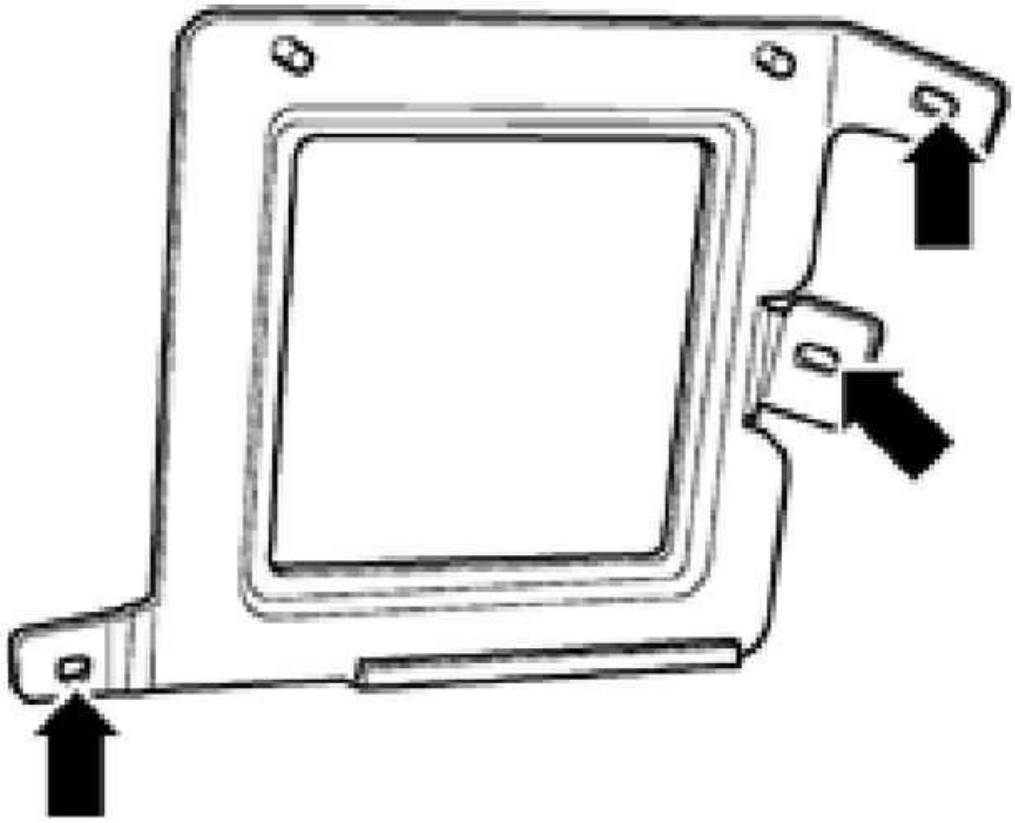


Fig. 45: Scan Tool Display - Engine Coolant Temperature Sensor (4 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

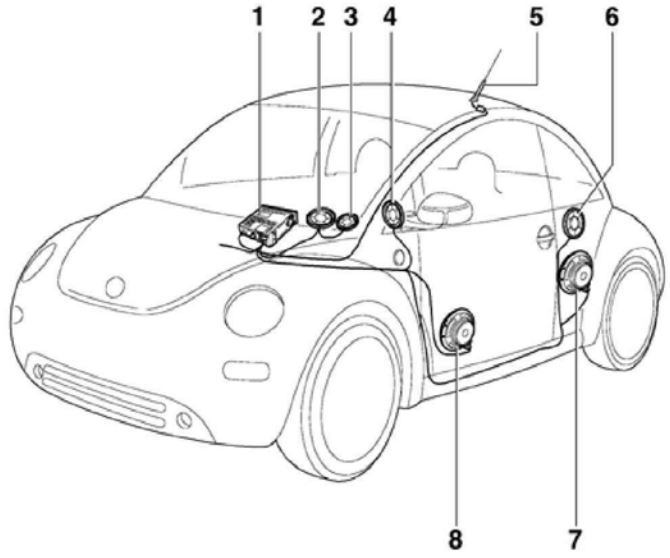
- Observe Engine Coolant Temperature value in Display zone 4.
- Temperature value must Increase uniformly without interruption.

NOTE: In the event of malfunctions, Fuel temperature is displayed as a substitute.

If an unrealistic value appears in Display zone 4 or Fuel temperature is displayed as a substitute

- Check Engine Coolant Temperature (ECT) Sensor -G62- and wiring to sensor as follows
- Press --> button.

Display will appear as shown:



1 - Radio

- In center console
- Removing and installing ⇒ Page 91-10

2 - Bass loudspeaker (with Monsoon only)

- In inner plenum under cover
- Removing ⇒ Page 91-22

3 - Domed treble loudspeaker (with Monsoon only)

- In inner plenum under covcer
- Removing ⇒ Page 91-22

4 - Domed treble loudspeaker

- In A-pillar
- Removing ⇒ Page 91-20

5 - Roof antenna

- Amplified mast type antenna mounted on roof ⇒ Page 91-29

6 - Not applicable

7 - Bass loudspeaker

- In rear side panel
- Removing and installing ⇒ Page 91-21

8 - Bass loudspeaker

- In front door
- Removing and instaling ⇒ Page 91-21

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Fig. 46: Scan Tool Display - Engine Coolant Temperature Sensor (5 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -6- buttons to select Function 06: "End output".

- Press -Q- button to enter input.
- Switch OFF ignition.
- Disconnect -G62- harness connector (arrow).

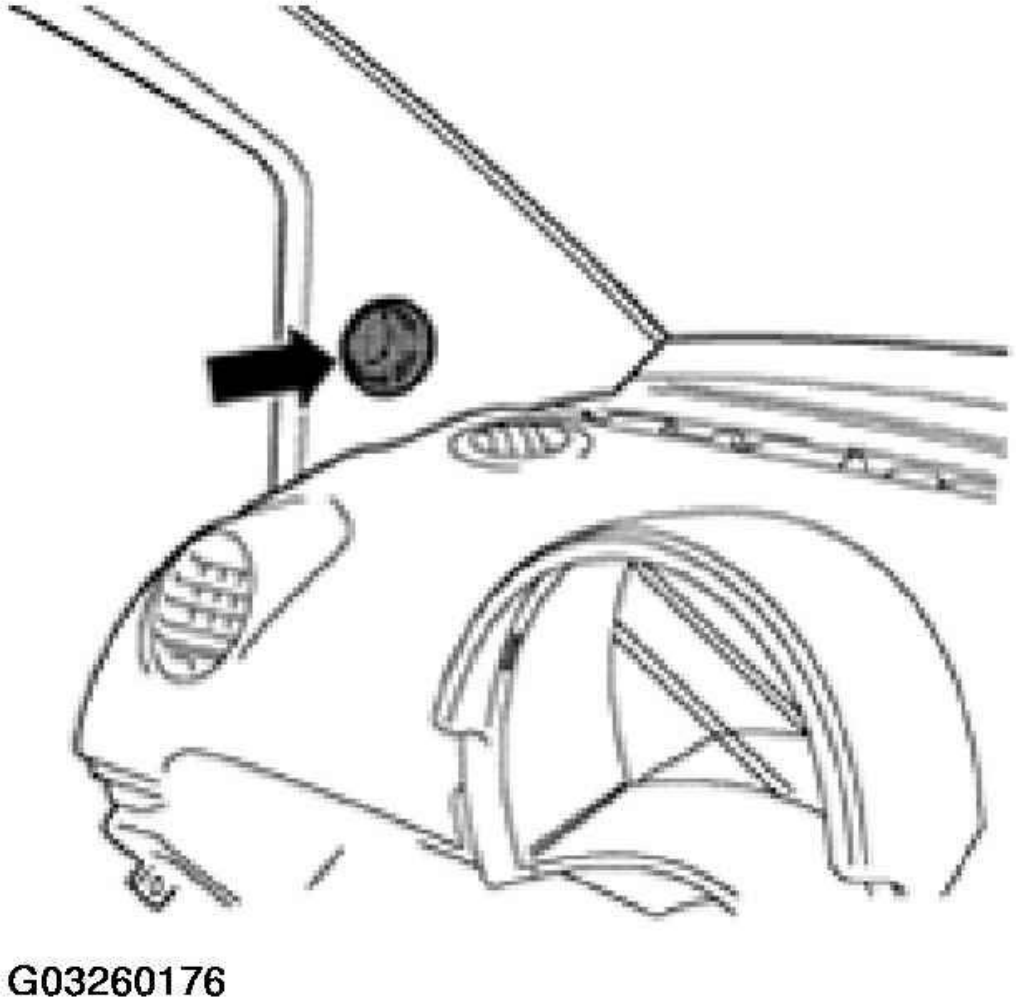

Fig. 47: Disconnecting ECT Sensor -G62- Harness Connector
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Measure resistance between sensor terminals 1 + 3.

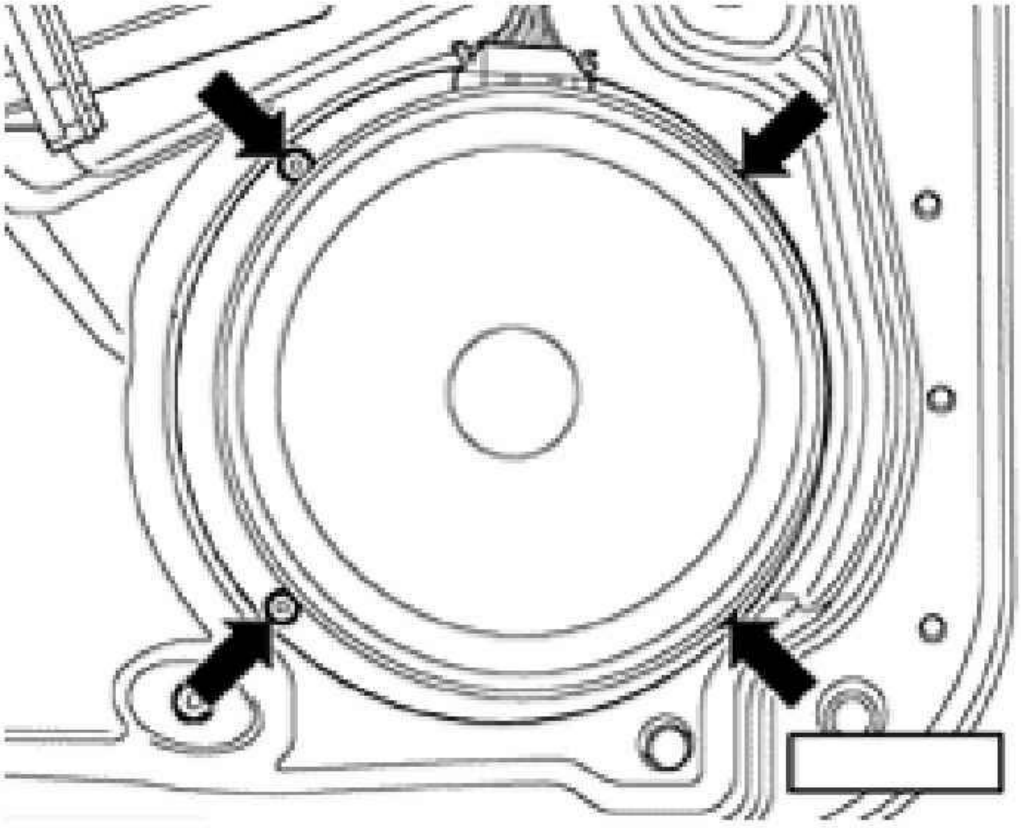

Fig. 48: Identifying Resistance Between ECT Sensor Terminals 1 And 3
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Specification (see diagram):

Scale A shows resistance values for temperature range 0 to 50 °C and scale B the values for temperature range 50 to 100 °C.

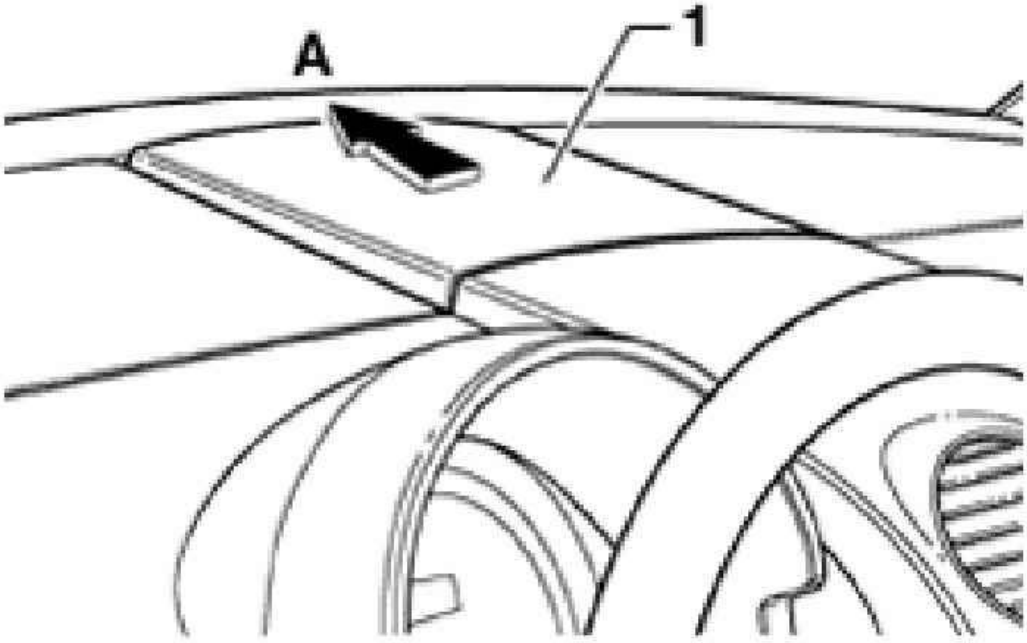

Fig. 49: ECT Sensor Resistance Versus Temperature Range Graph
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Examples:

- 30 °C corresponds to a resistance from 1500 to 2000 ohm
- 80 °C corresponds to a resistance from 275 to 375 ohm

If specification not obtained:

- Replace Engine Coolant Temperature (ECT) Sensor -G62-.
- Display the Readiness code. See **READINESS CODE, DISPLAYING** .

If DTC memory was erased:

- Set the readiness code. See **READINESS CODE, SETTING** .

  If specification obtained:

- Connect VAG1598/22 (or 1598/31) Test Box to ECM wiring harness.

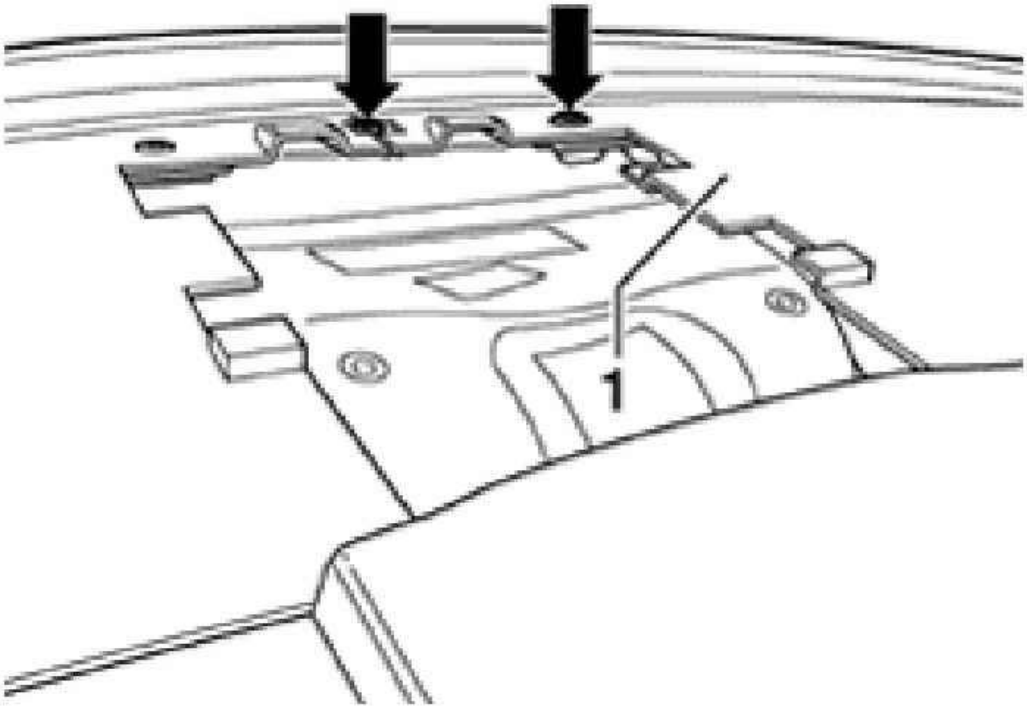

Fig. 50: Connecting VAG1598/22 (Or 1598/31) Test Box To ECM Wiring Harness
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check wiring for open circuit between Test Box and 4-pin harness connector using Wiring diagram.

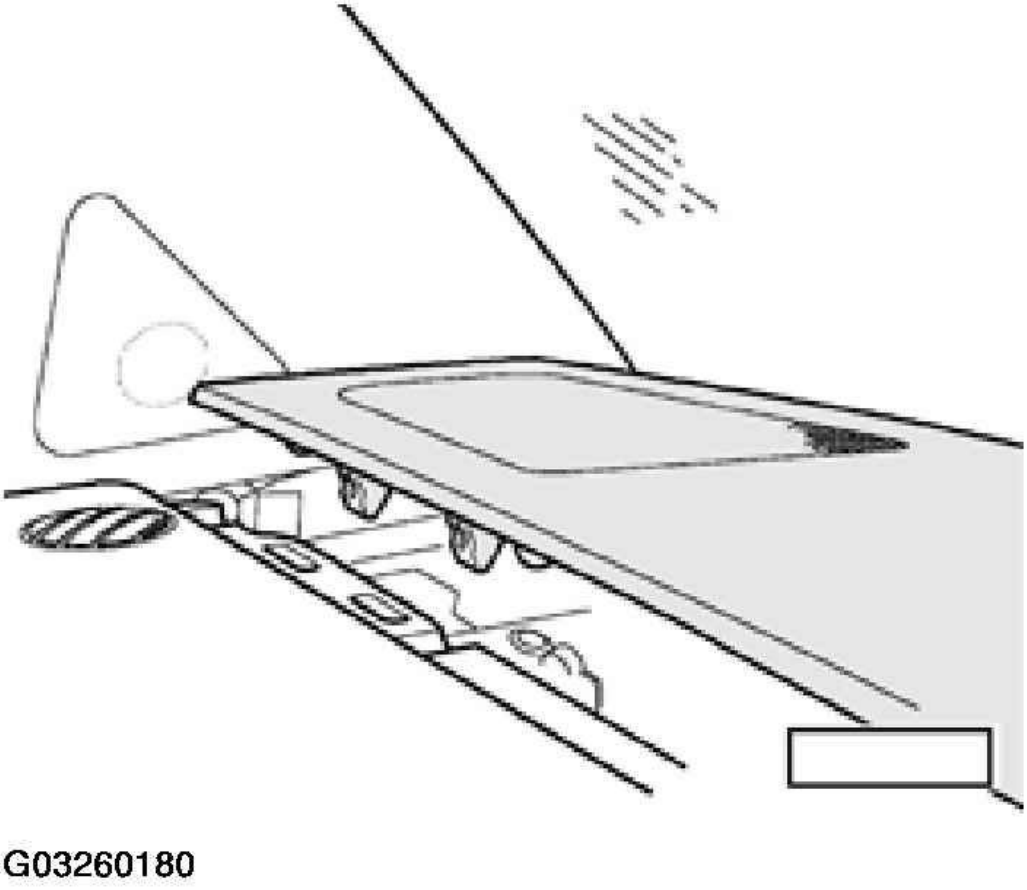

Fig. 51: Identifying ECT Sensor Harness Connector Terminals 1 And 3
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Up to MY 1999

- Terminal 1 + socket 70
- Terminal 3 + socket 54

From MY 2000

- Terminal 3 + socket 112
- Terminal 4 + socket 104

- Wire resistance: 1.5ohm maximum

- Check wires for shorting to: one another, Ground and Battery +

- Specification: INFINITY ohm

If wiring OK:

- Replace Engine Control Module -J248-. See **Engine Control Module (ECM), replacing** .
- Erase DTC memory. See **DTC MEMORY, ERASING** . (Disconnecting the Engine Coolant Temperature sensor generates a DTC).

Brake Light Switch -F63- and Brake Vacuum Vent Valve Switch for Cruise Control/Diesel Fuel Injection -F47-, checking

The Diesel injection system senses throttle pedal travel via the Throttle Position Sensor -G79-. As with any mechanical device, -G79- could be faulty. For reasons of safety, engine speed is regulated when the brakes are applied. To accomplish this, the ECM requires signals from the Brake Light Switch -F- and the Brake Vacuum Vent Valve Switch -F47-. This means that if the brakes are applied while the throttle pedal is depressed, engine speed will immediately drop to an idle. An incorrectly adjusted switch could lead to unnecessary regulating action.

Special tools

- VAG1551/1552 Scan Tool using VAG1551/3 Adapter cable
- VAG1598/22 Test Box (MY 1999)
- VAG1598/31 Test Box (from MY 2000)
- Fluke 83 multimeter
- VW 1594 Adapter kit
- Wiring diagram

Test sequence

- Connect VAG1551/1552 Scan Tool. See **VAG1551/1552 SCAN TOOL, CONNECTING** .
- Switch ON ignition but do not start engine.
- Press -0- and -1- buttons to select Address word 01: "Engine electronics"

Display will appear as shown (example only):

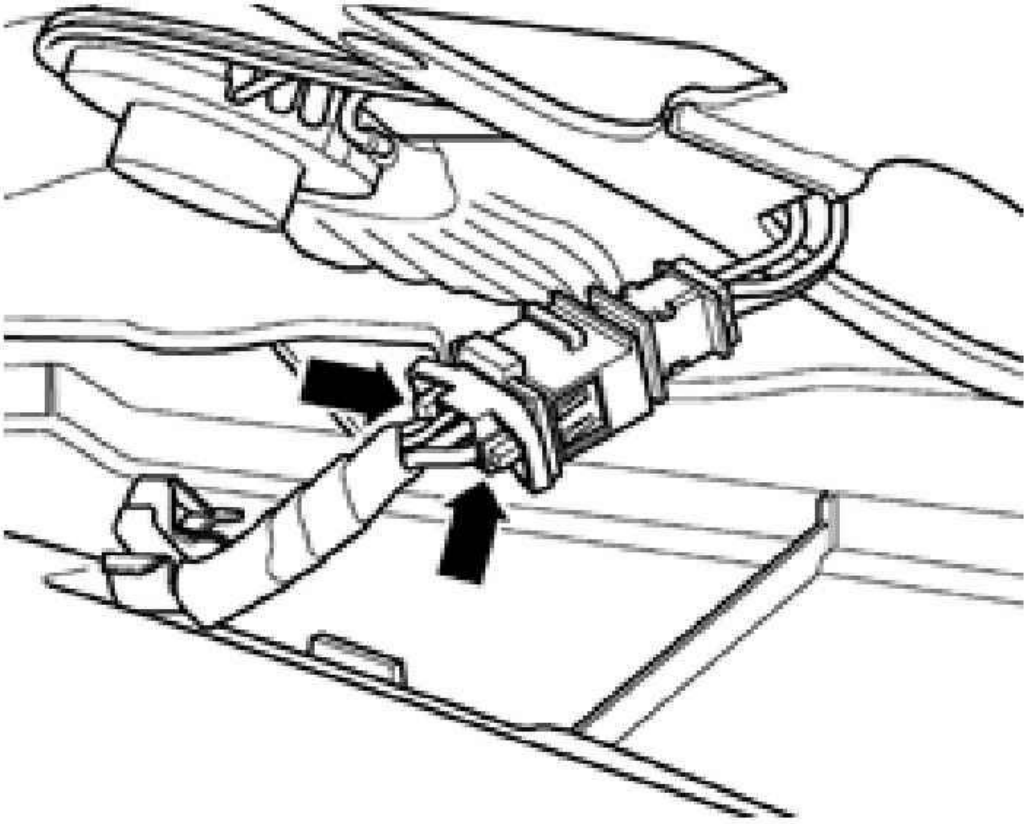

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Fig. 52: Scan Tool Display - Brake Light Switch & Brake Vacuum Vent Valve Switch (1 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press --> button.

Display will appear as shown:

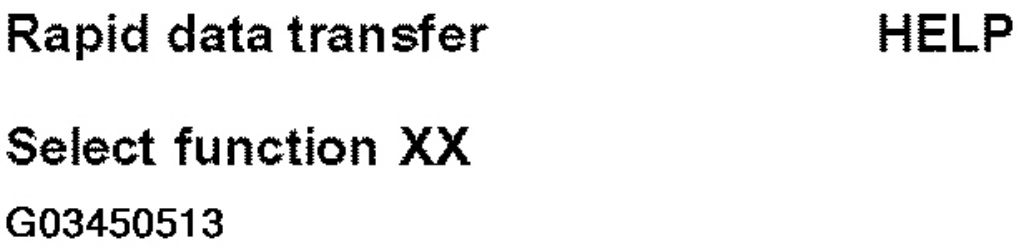

Fig. 53: Scan Tool Display - Brake Light Switch & Brake Vacuum Vent Valve Switch (2 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -8- buttons to select Function 08: "Read measuring value block".
- Press -Q- button to enter input.

Display will appear as shown:

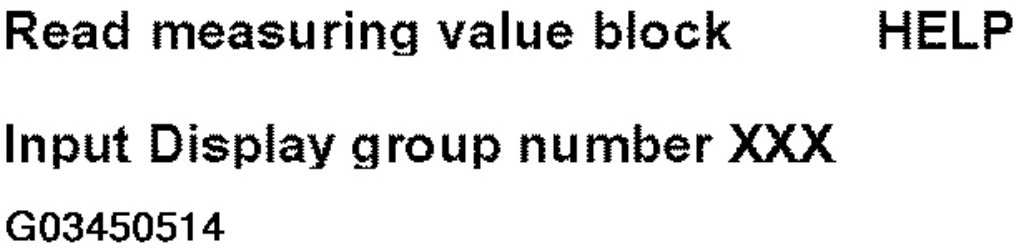

Fig. 54: Scan Tool Display - Brake Light Switch & Brake Vacuum Vent Valve Switch (3 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press buttons -0-, -0- and -6- to select "Display group 6".
- Press -Q- button to enter input.
- Observe values in Display zone 2.

Specification: 0 0 0

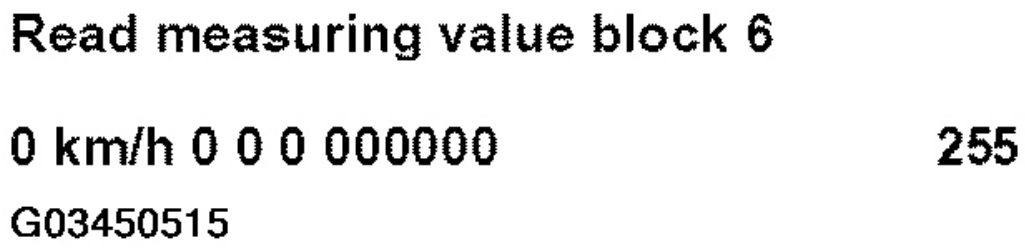

Fig. 55: Scan Tool Display - Brake Light Switch & Brake Vacuum Vent Valve Switch (4 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Slowly operate brake pedal.
- Specification: 0 1 1

Both displays must change from 0 to 1 at same time.

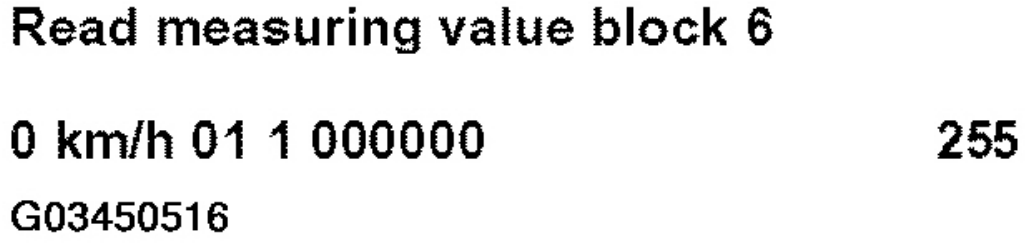

Fig. 56: Scan Tool Display - Brake Light Switch & Brake Vacuum Vent Valve Switch (5 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Center display = Brake Vacuum Vent Valve Switch -F47-
- Right-hand display = Brake Light Switch -F-
- Slowly release brake pedal to rest position again.

Both displays must change from 1 to 0 again.

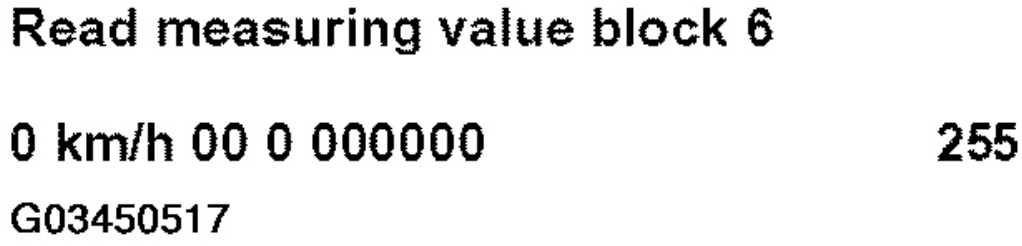

Fig. 57: Scan Tool Display - Brake Light Switch & Brake Vacuum Vent Valve Switch (6 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

If one or both displays do not change:

- Adjust switch point for -F47- by turning switch.
- Adjust switch point for -F- by moving plunger.
- Check switches or wiring to the switches:

  See appropriate System Wiring Diagram article.

- Display the Readiness code. See **READINESS CODE, DISPLAYING** .

If DTC memory was erased:

- Set the readiness code. See **READINESS CODE, SETTING** .

Clutch Vacuum Vent Valve Switch -F36-, checking

Clutch Vacuum Vent Valve Switch -F36- informs the ECM when the clutch is being engaged or disengaged. This prevents the engine from jerking when disengaging and engaging. It also prevents the engine from racing during disengagement operations when the Cruise Control System is switched ON.

Special tools

- VAG1551/1552 Scan Tool using VAG1551/3 Adapter cable
- VAG1598/22 Test Box (MY 1999)
- VAG1598/31 Test Box (from MY 2000)
- Fluke 83 multimeter
- VW 1594 Adapter kit
- Wiring diagram

Test sequence

- Connect VAG1551/1552 Scan Tool. See **VAG1551/1552 SCAN TOOL, CONNECTING** .
- Switch ON ignition but do not start engine.
- Press -0- and -1- buttons to select Address word 01: "Engine electronics"

Display will appear as shown (example only):

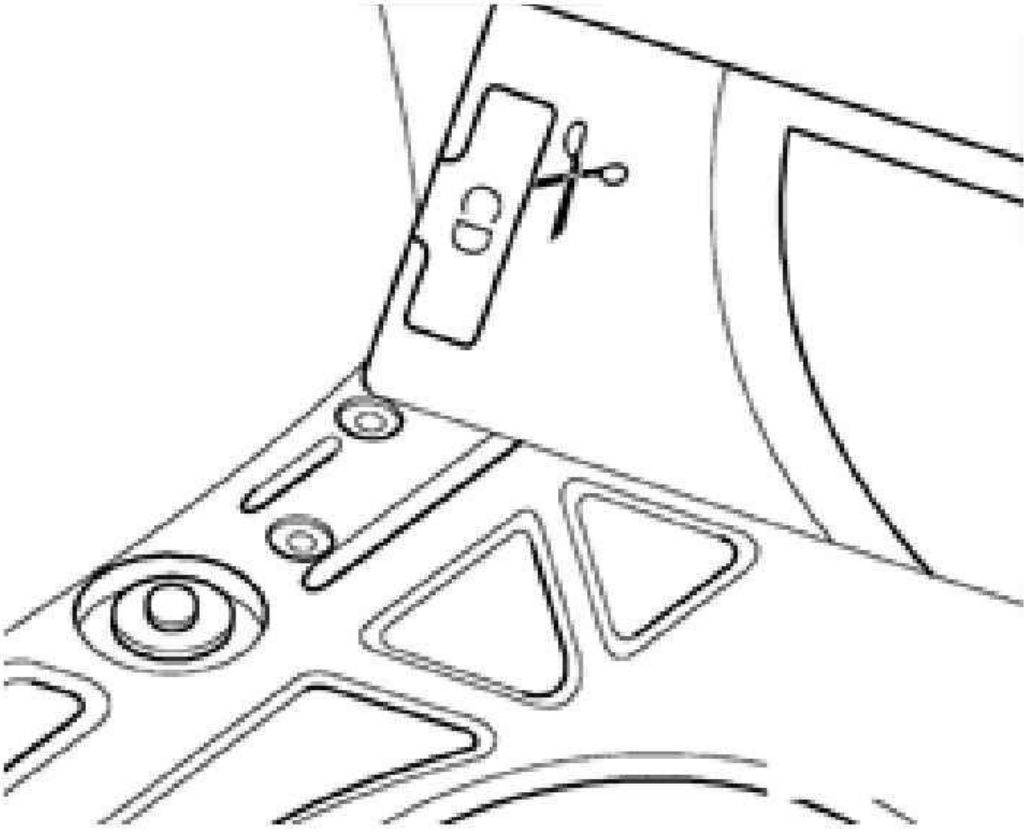

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Fig. 58: Scan Tool Display - Clutch Vacuum Vent Valve Switch (1 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press --> button.

Display will appear as shown:

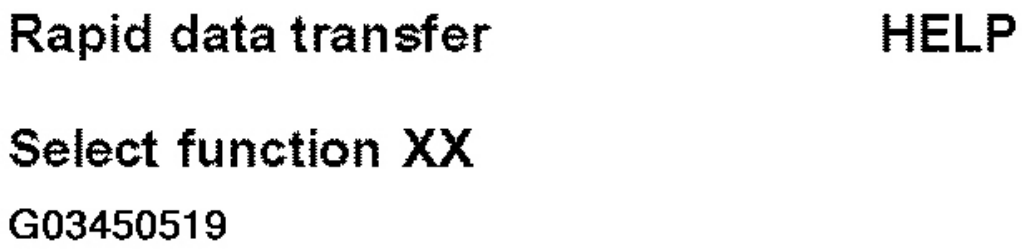

Fig. 59: Scan Tool Display - Clutch Vacuum Vent Valve Switch (2 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -8- buttons to select Function 08: "Read measuring value block".
- Press -Q- button to enter input.

Display will appear as shown:

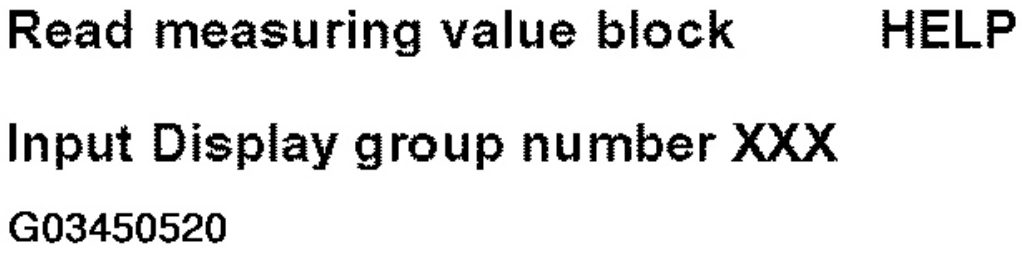

Fig. 60: Scan Tool Display - Clutch Vacuum Vent Valve Switch (3 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press buttons -0-, -0- and -6- to select "Display group 6".
- Observe value in Display zone 2.

Specification: 0 0 0

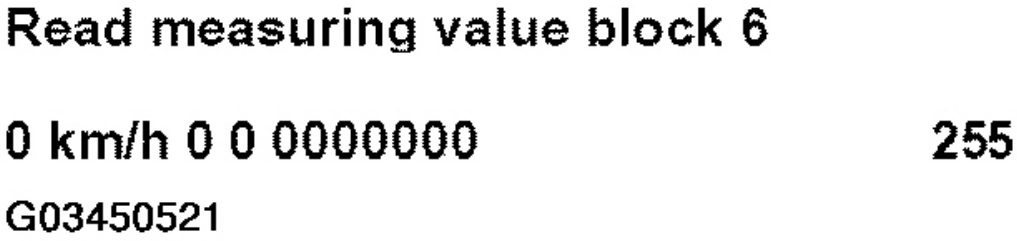

Fig. 61: Scan Tool Display - Clutch Vacuum Vent Valve Switch (4 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Operate clutch pedal.
- Left-hand position value must change to 1.

Specification: 1 0 0

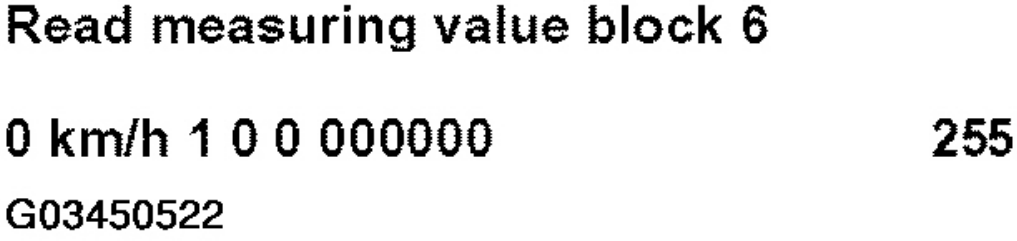

Fig. 62: Scan Tool Display - Clutch Vacuum Vent Valve Switch (5 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

If specifications not obtained:

- Press --> button.

Display will appear as shown:

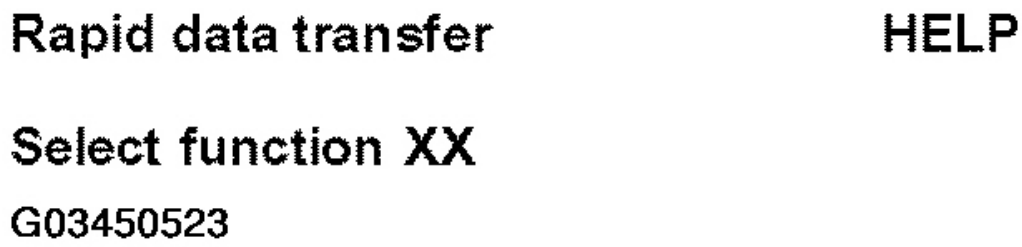

Fig. 63: Scan Tool Display - Clutch Vacuum Vent Valve Switch (6 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -6- buttons to select Function 06: "End output".
- Press -Q- button to enter input.
- Switch OFF ignition.

- Disconnect Clutch Vacuum Vent Valve Switch -F36- harness connector. See **DIESEL INJECTION SYSTEM, COMPONENT LOCATIONS OVERVIEW** .
- Switch Fluke 83 multimeter to resistance range.
- Measure resistance at switch terminals.

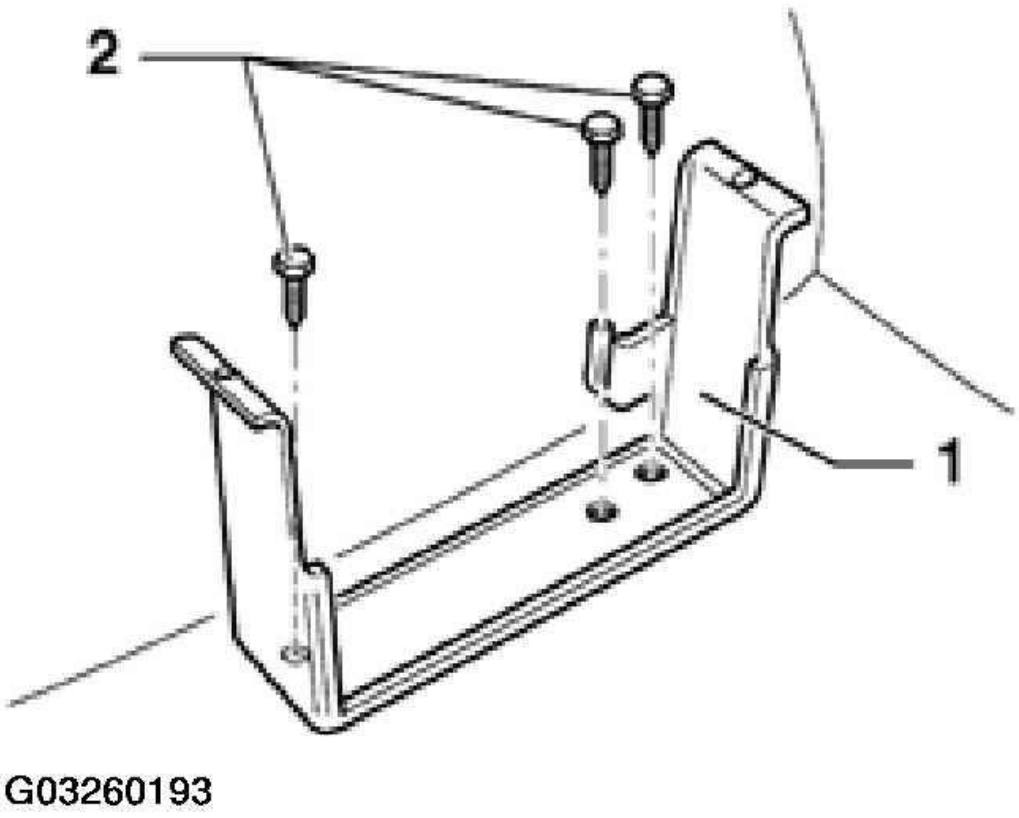

Fig. 64: Measuring Resistance At Clutch Vacuum Vent Valve Switch Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Specification:
  - Clutch not depressed: maximum 10 ohm
  - Clutch depressed: INFINITY ohm

If specifications not obtained:

- Replace Clutch Vacuum Vent Valve Switch -F36-.
- Display the Readiness code. See **READINESS CODE, DISPLAYING** .

If DTC memory has been erased:

- Set the Readiness code again. See **READINESS CODE, SETTING** .

If specifications obtained:

- Connect VAG1598/22 (or 1598/31) Test Box to ECM wiring harness.

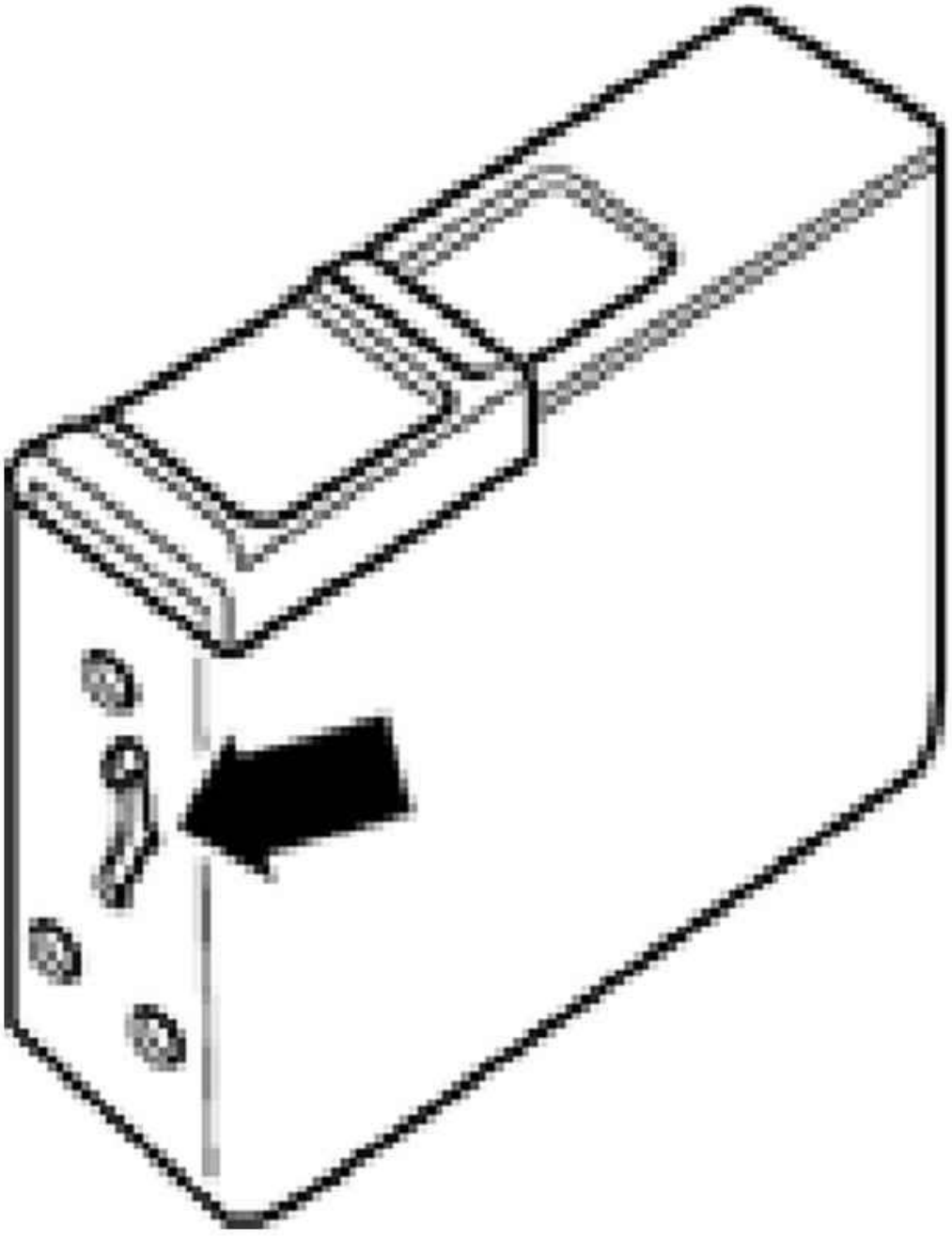

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Fig. 65: Connecting VAG1598/22 (Or 1598/31) Test Box To ECM Wiring Harness
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check wiring for open circuit between Test Box and harness connector using Wiring diagram.

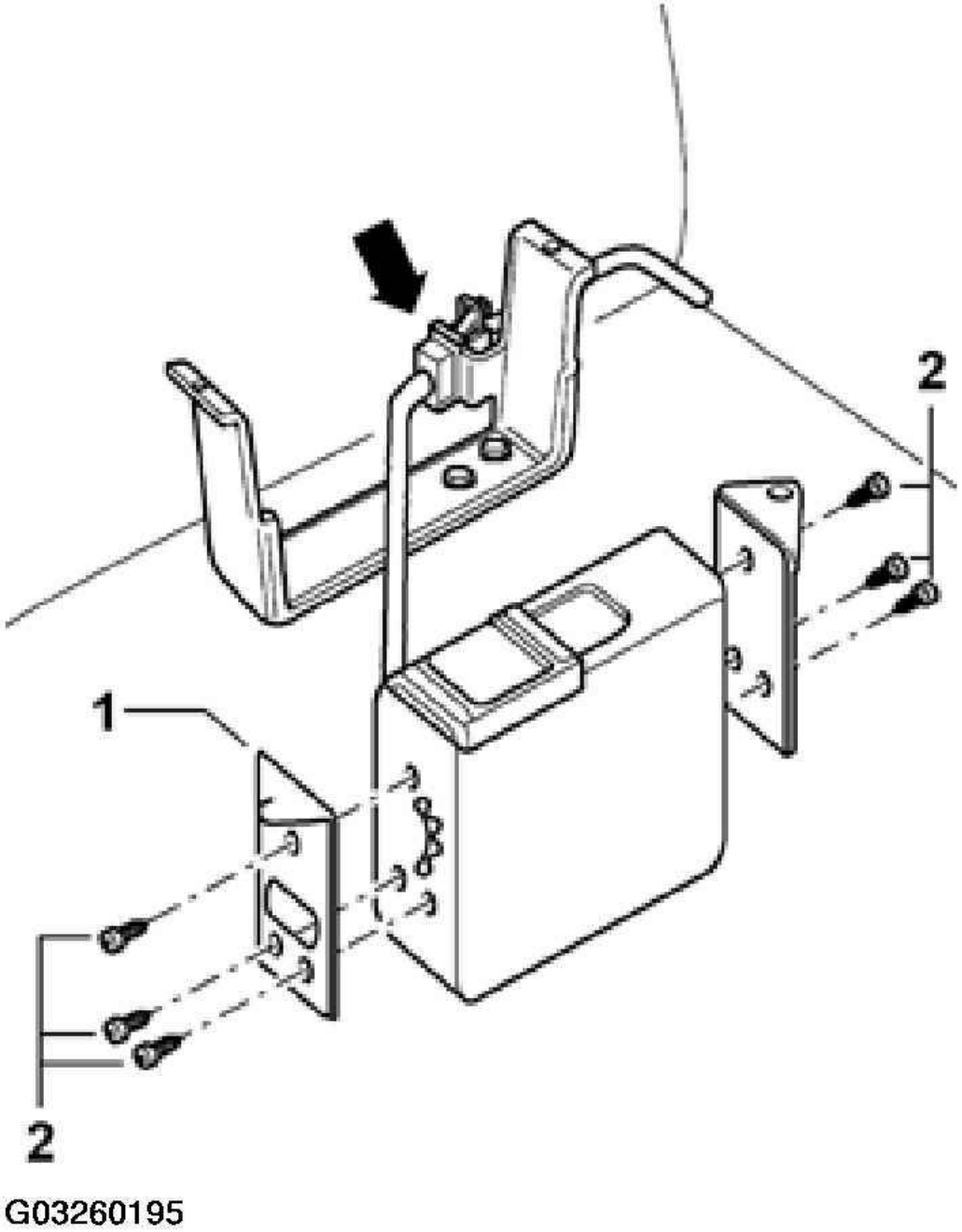

Fig. 66: Identifying Clutch Vacuum Vent Valve Switch Harness Connector Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Up to MY 1999

- Terminal 1 + socket 2
- Terminal 1 + socket 28
- Terminal 2 + socket 46

From MY 2000

- Terminal 1 + socket 1
- Terminal 1 + socket 2
- Terminal 2 + socket 66

- Wire resistance: 1.5ohm maximum

- Check wires for shorting to: one another, Ground and Battery +

- Specification: INFINITY ohm

If wiring OK:

- Replace Engine Control Module -J248-. See **Engine Control Module (ECM), replacing** .
- Display the Readiness code. See **READINESS CODE, DISPLAYING** .

If DTC memory was erased:

- Set the readiness code. See **READINESS CODE, SETTING** .

Intake Air Temperature (IAT) Sensor -G72-, checking

Special tools

- VAG1551/1552 Scan Tool using VAG1551/3 Adapter cable
- VAG1598/22 Test Box (MY 1999)
- VAG1598/31 Test Box (from MY 2000)
- Fluke 83 multimeter
- VW 1594 Adapter kit
- Wiring diagram

Test sequence

- Connect VAG1551/1552 Scan Tool. See **VAG1551/1552 SCAN TOOL, CONNECTING** .
- Start engine and let idle.
- Press -0- and -1- buttons to select Address word 01: "Engine electronics"

Display will appear as shown (example only):

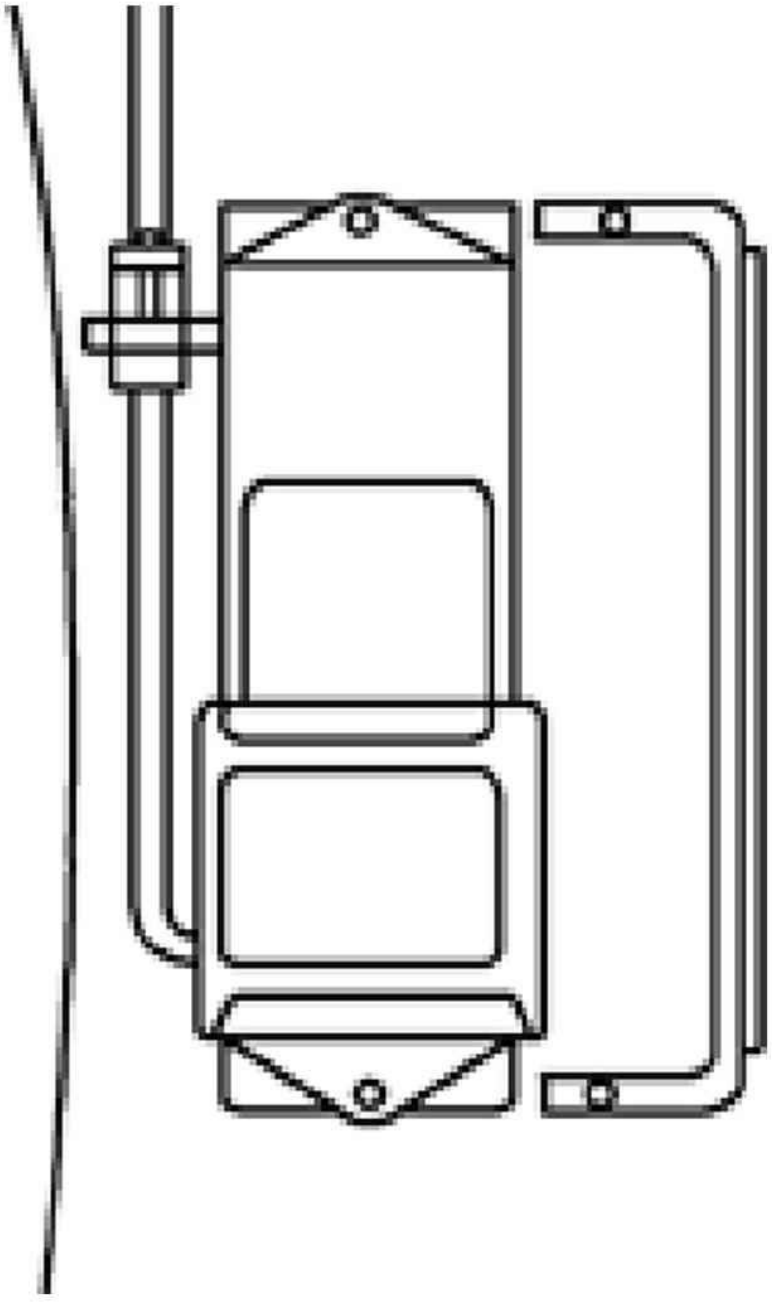

Fig. 67: Scan Tool Display - Intake Air Temperature Sensor (1 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press --> button.

Display will appear as shown:

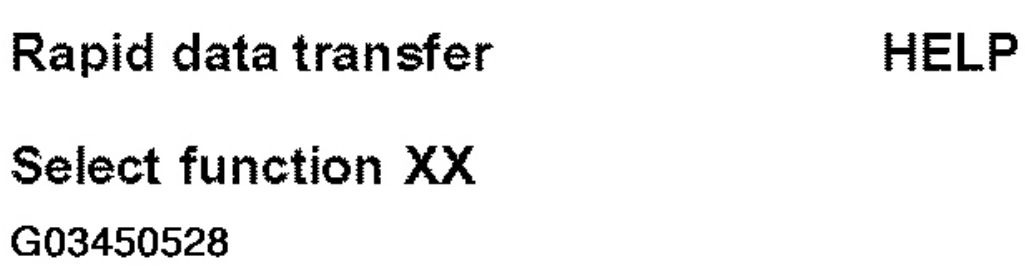

Fig. 68: Scan Tool Display - Intake Air Temperature Sensor (2 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -8- buttons to select Function 08: "Read measuring value block".
- Press -Q- button to enter input.

Display will appear as shown:

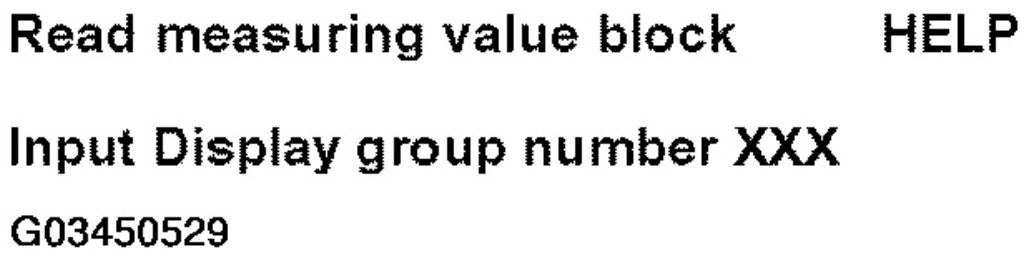

Fig. 69: Scan Tool Display - Intake Air Temperature Sensor (3 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press buttons -0-, -0- and -7- to select "Display group 7".
- Press -Q- button to enter input.
- Display will appear as shown:

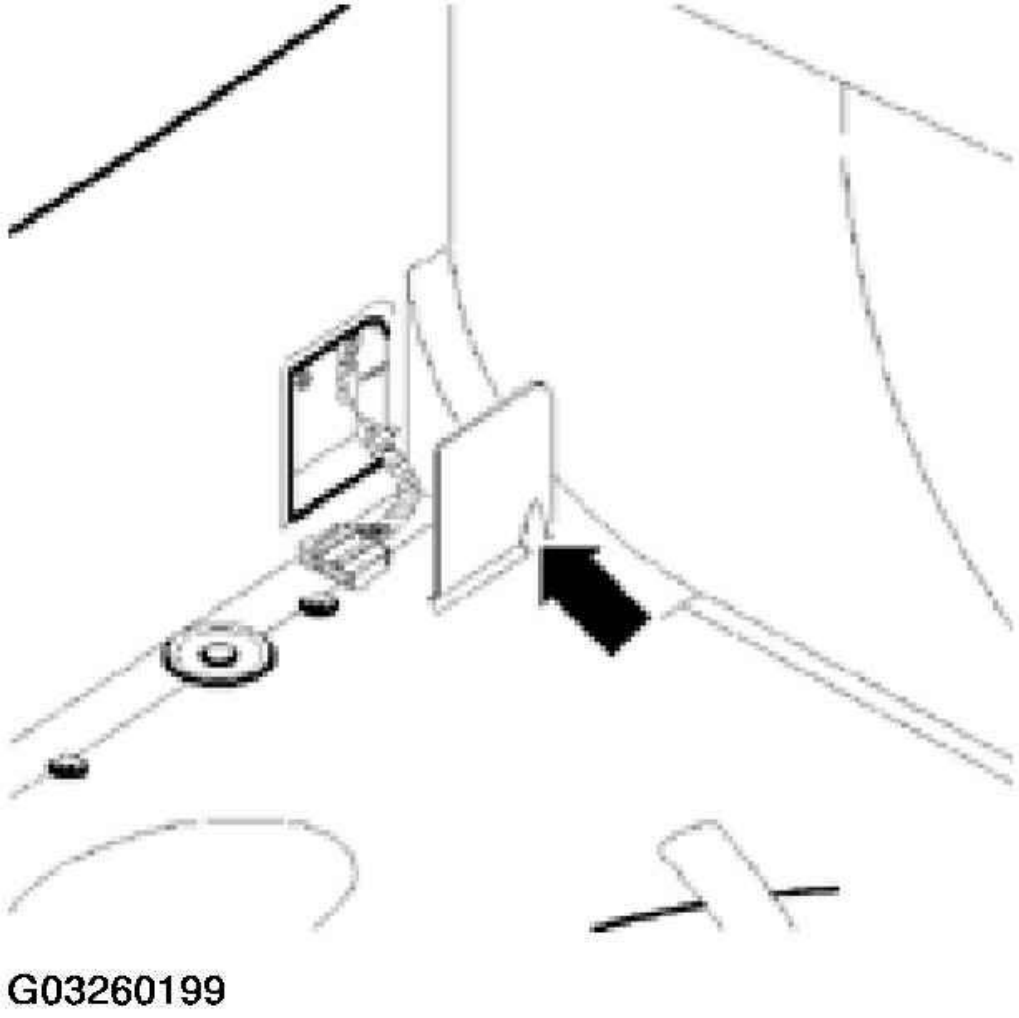

Fig. 70: Scan Tool Display - Intake Air Temperature Sensor (4 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

If an unrealistic value appears in Display zone 3 or a substitute temperature of 136.8 °C is displayed

- Check Intake Air Temperature (IAT) Sensor -G72- and wiring to sensor as follows:
- Press --> button.

Display will appear as shown:

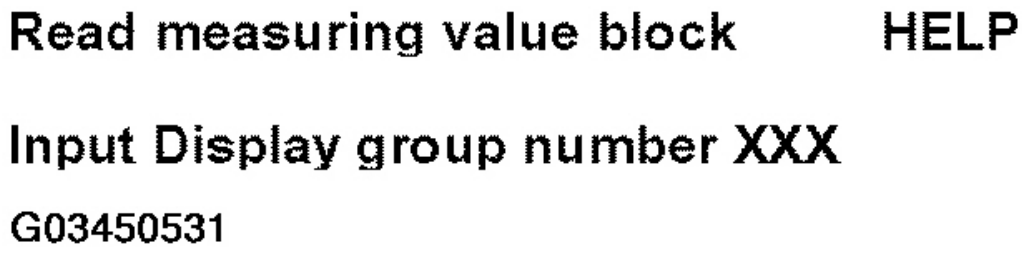

Fig. 71: Scan Tool Display - Intake Air Temperature Sensor (5 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -6- buttons to select Function 06: "End output".
- Press -Q- button to enter input.
- Switch OFF ignition.
- Disconnect -G72- harness connector: Component locations overview. See **DIESEL INJECTION SYSTEM, COMPONENT LOCATIONS OVERVIEW** .

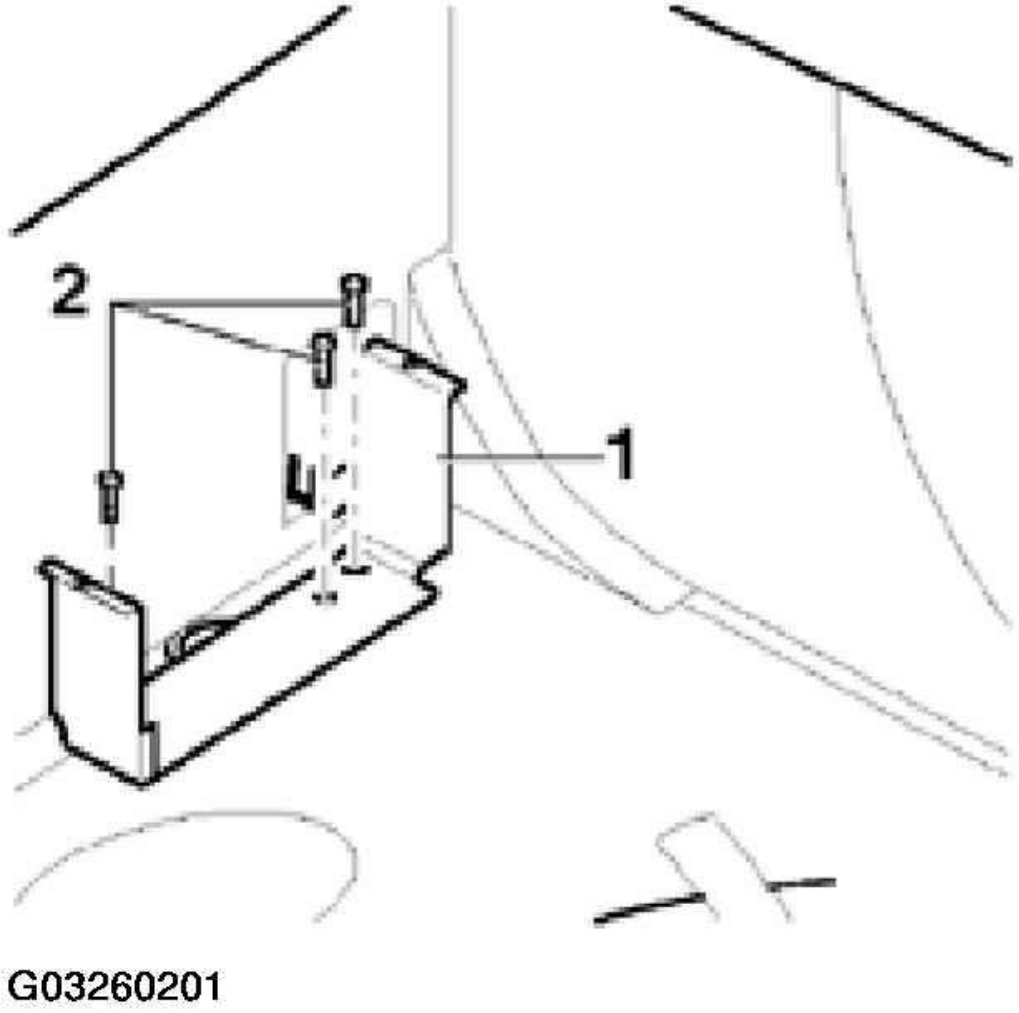

Fig. 72: Identifying IAT Sensor -G72- Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Measure resistance between sensor terminals 1 + 2.

Specification (see **Fig. 73**):

Scale A shows resistance values for temperature range 0 to 50 °C and scale B the values for temperature range 50 to 100 °C.

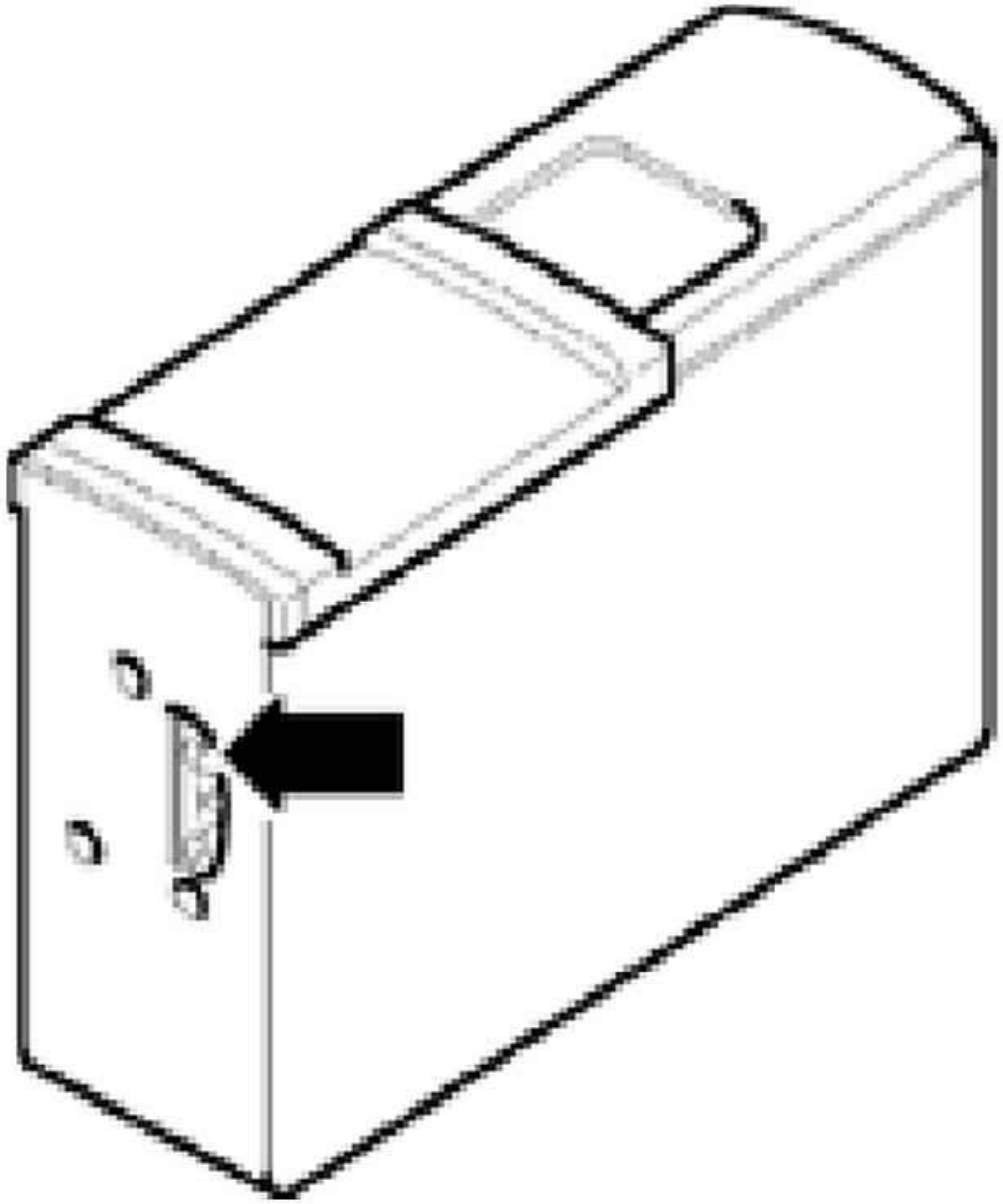

Fig. 73: IAT Sensor Resistance Versus Temperature Range Graph
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Examples:

- 30 °C corresponds to a resistance from 1500 to 2000ohm
- 80 °C corresponds to a resistance from 275 to 375ohm

If specification not obtained:

- Replace Intake Air Temperature (IAT) Sensor -G72-.
- Display the Readiness code. See **READINESS CODE, DISPLAYING** .

If DTC memory was erased:

- Set the readiness code. See **READINESS CODE, SETTING** .

If specification obtained:

- Connect VAG1598/22 (or 1598/31) Test Box to ECM wiring harness.

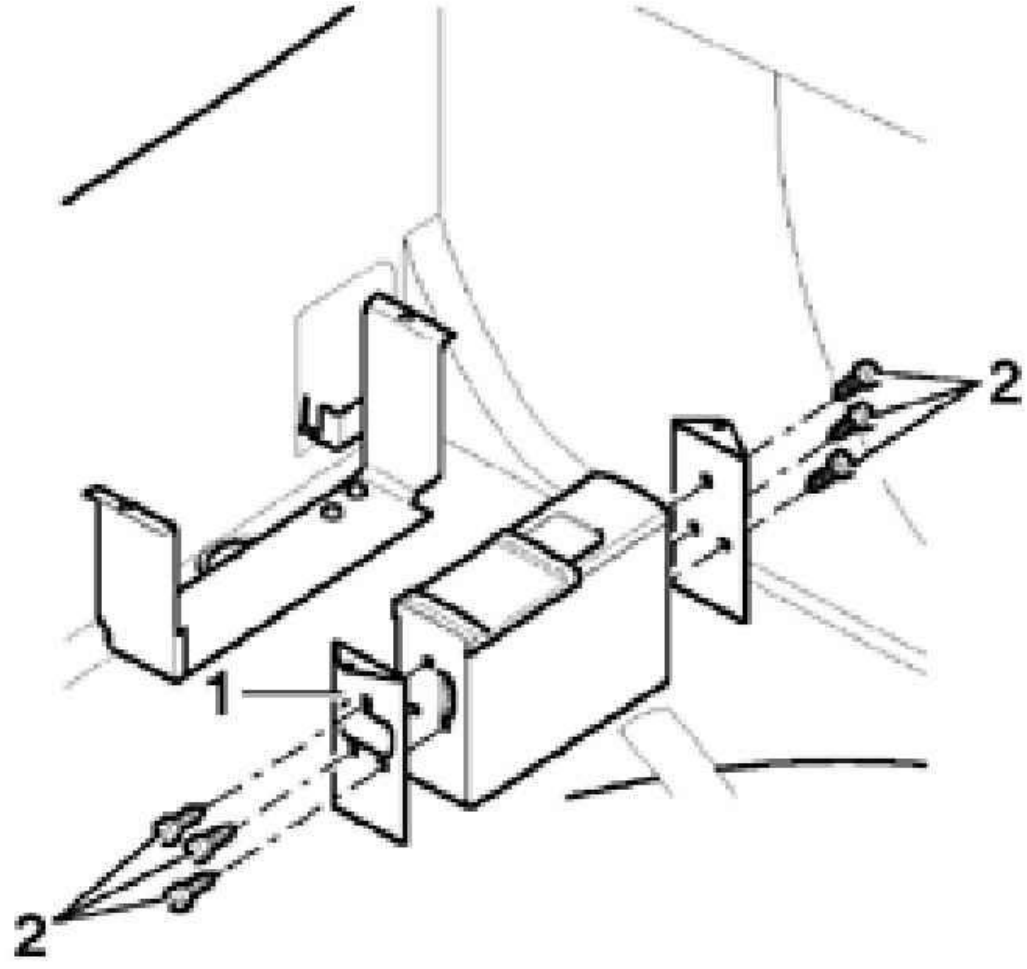

Fig. 74: Connecting VAG1598/22 (Or 1598/31) Test Box To ECM Wiring Harness
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check wiring between Test Box and connector for open circuit using Wiring diagram.

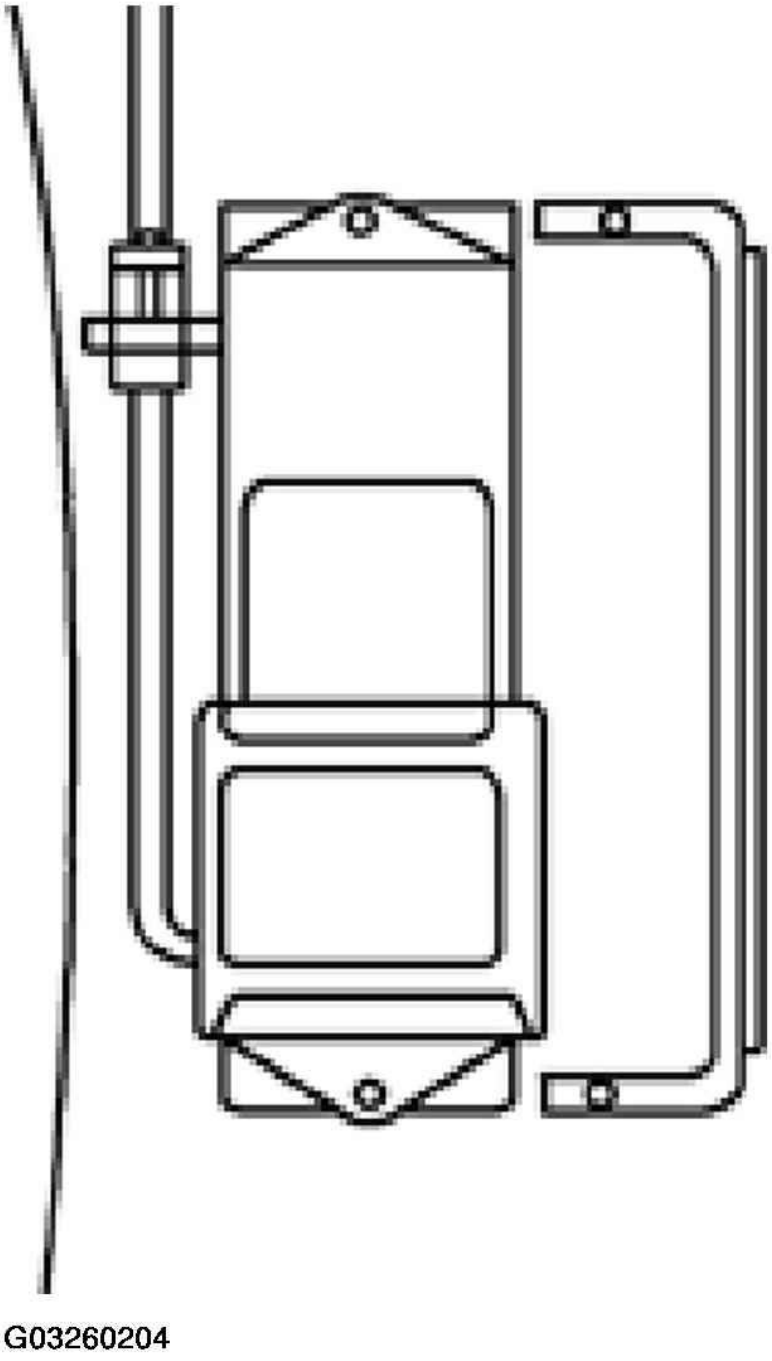

Fig. 75: Identifying IAT Sensor Harness Connector Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Terminal 1 + socket 25

- Terminal 2 + socket 13
- Wire resistance: maximum 1.5ohm
- Check wires for short to one another, to Ground and to Battery +
- Specification: INFINITY ohm

If wiring OK:

- Replace Engine Control Module -J248-. See **Engine Control Module (ECM), replacing** .
- Display the Readiness code. See **READINESS CODE, DISPLAYING** .

If DTC memory was erased:

- Set the readiness code. See **READINESS CODE, SETTING** .

Fuel Temperature Sensor -G81-, checking

Special tools

- VAG1551/1552 Scan Tool using VAG1551/3 Adapter cable
- VAG1598/22 Test Box (MY 1999)
- VAG1598/31 Test Box (from MY 2000)
- Fluke 83 multimeter
- VW 1594 Adapter kit
- Wiring diagram

Test sequence

- Connect VAG1551/1552 Scan Tool. See **VAG1551/1552 SCAN TOOL, CONNECTING** .
- Start engine and let idle.
- Press -0- and -1- buttons to select Address word 01: "Engine electronics"

Display will appear as shown (example only):

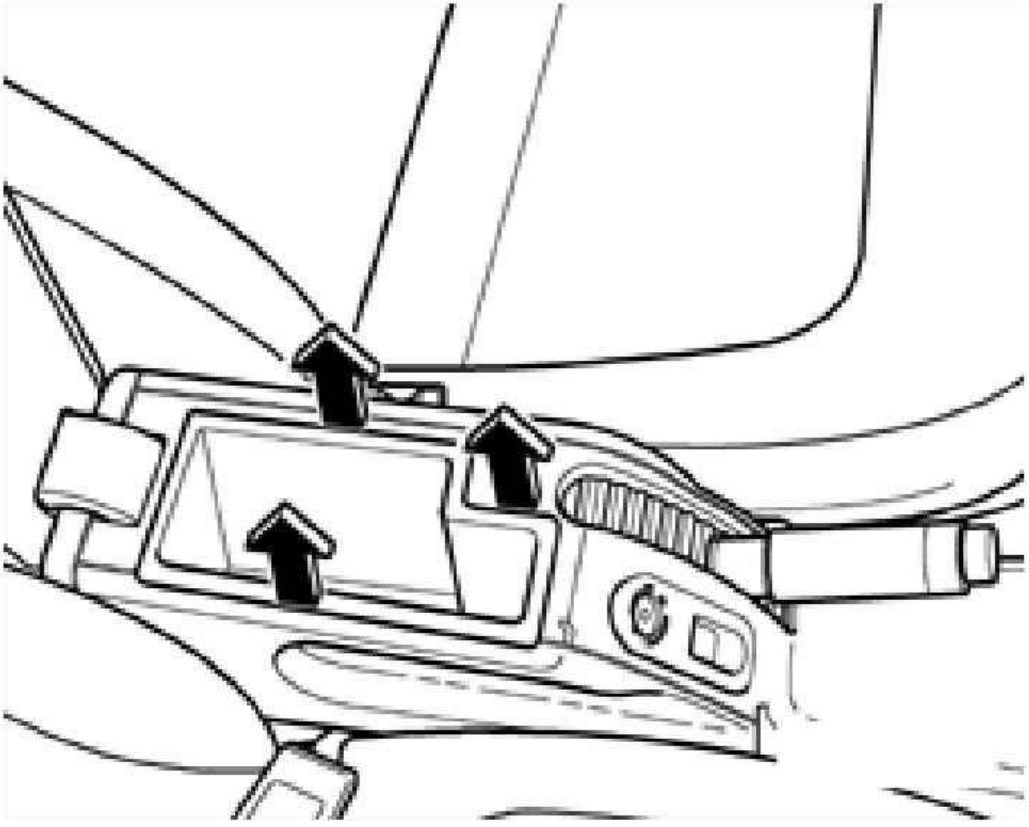

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Fig. 76: Scan Tool Display - Fuel Temperature Sensor (1 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press --> button.

Display will appear as shown:

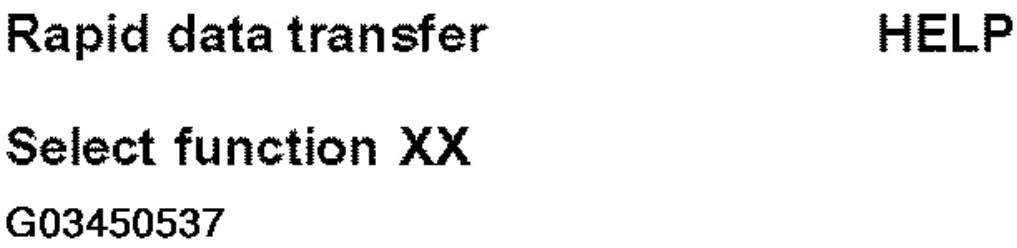


Fig. 77: Scan Tool Display - Fuel Temperature Sensor (2 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -8- buttons to select Function 08: "Read measuring value block"
- Press -Q- button to enter input.

Display will appear as shown:

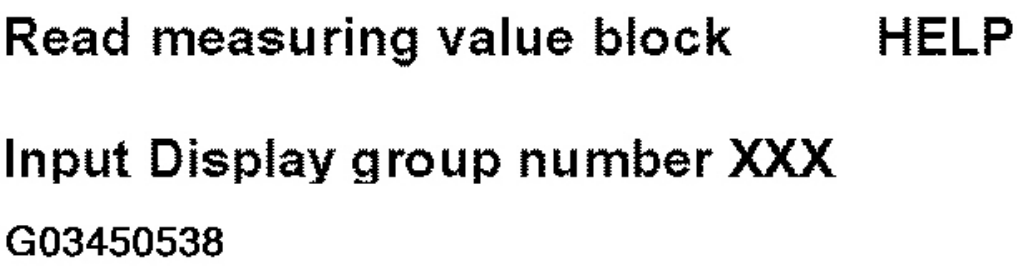


Fig. 78: Scan Tool Display - Fuel Temperature Sensor (3 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press buttons -0-, -0- and -7- to select "Display group 7".
- Press -Q- button to enter input.
- Display will appear as shown:

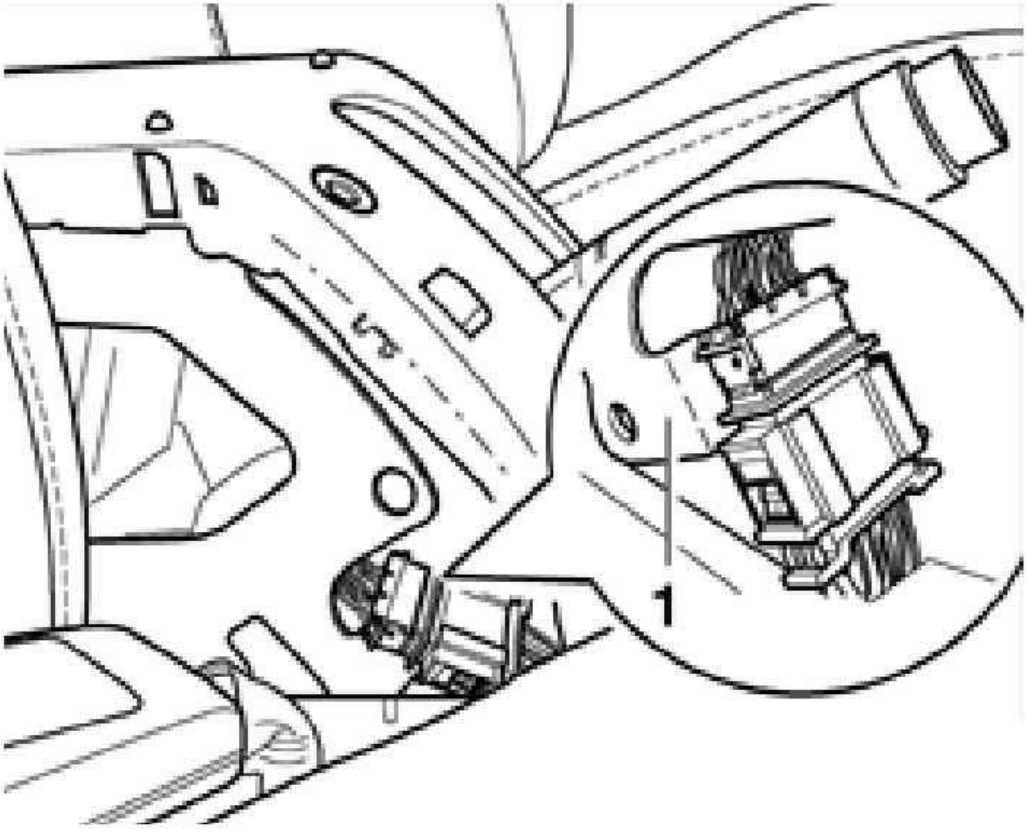


Fig. 79: Scan Tool Display - Fuel Temperature Sensor (4 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

If an unrealistic value appears in Display zone 1 or a substitute temperature of -5.4 C is displayed:

- Check Fuel Temperature Sensor -G81- and wiring to sensor as follows:
- Press --> button.

Display will appear as shown.

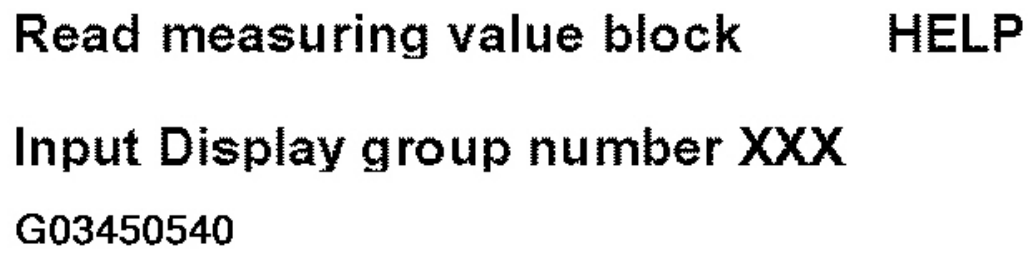


Fig. 80: Scan Tool Display - Fuel Temperature Sensor (5 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -6- buttons to select Function 06: "End output".
- Switch OFF ignition.
- Disconnect 10-pin -G81- harness connector (connection to Diesel injection pump metering control).

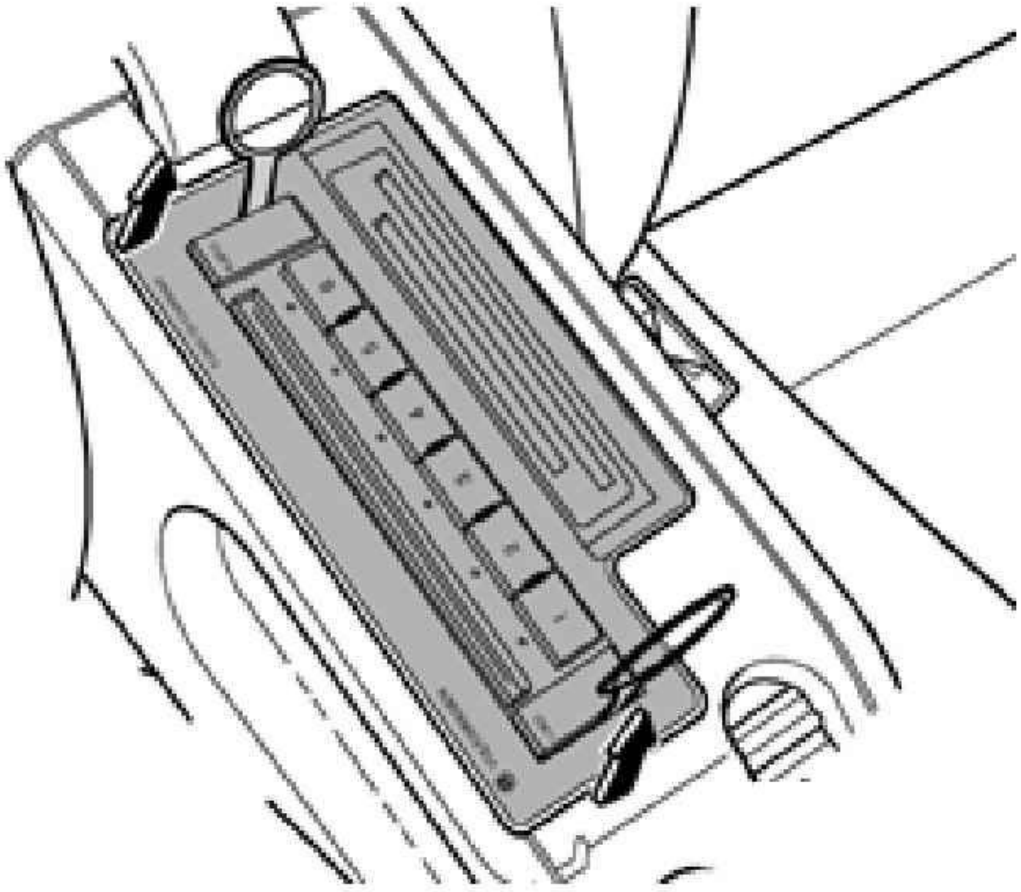
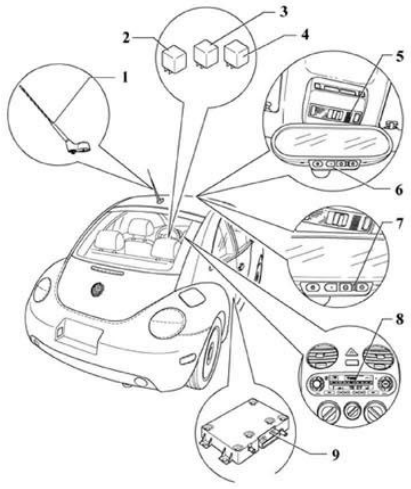


Fig. 81: Identifying 10-Pin -G81- Connector Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Measure Fuel Temperature sensor resistance between terminals 4 + 7.

Specification chart:

Scale A shows resistance values for temperature range 0 to 50 °C and scale B the values for temperature range 50 to 100 °C.



1 - Antenna -R11-, Antenna Amplifier -R24- and Antenna for Navigation System (GPS) -R50-

- On roof, rear
- Removing and installing

2 - Dual Horn Auxiliary Relay -J733-

- On 13-position auxiliary relay panel, above relay panel.

3 - Auxiliary Emergency Flasher Relay -J517-

- On 13-position auxiliary relay panel, above relay panel.

4 - Warning Lamp Auxiliary Relay -J734-

- On 13-position auxiliary relay panel, above relay panel.

5 - Telephone Microphone -R38-

- Integrated with front interior light module.
- Removing and installing

6 - Telematic Control Head -E264-

- Integrated with rear view mirror.
- OnStar® buttons, description
- Includes telematics indicator lamp -7-.
- Removing and installing

7 - Telematics Indicator Lamp -K186-

- In Telematic Control Head.
- LED indicates telematic system operational status. Description
- Telematic system, troubleshooting using telematics indicator lamp

8 - Radio -R-

- In center console.

9 - Telematic Control Module -J499-

- Installed behind right rear side panel trim under rear speaker.
- Removing and installing
- Control module multi-pin connector terminal assignments

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Fig. 82: Fuel Temperature Sensor Resistance Versus Temperature Range Graph
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Examples:

- 30 °C corresponds to a resistance between 1500 and 2000 ohm
- 80 °C corresponds to a resistance between 275 and 375 ohm

If specification not obtained:

- Replace Diesel injection pump. See **DIESEL INJECTION PUMP, REMOVING AND INSTALLING** .
- Display the Readiness code. See **READINESS CODE, DISPLAYING** .

If DTC memory was erased:

- Set the readiness code. See **READINESS CODE, SETTING** .

If specification obtained:

- Connect VAG1598/22 (or 1598/31) Test Box to ECM wiring harness.

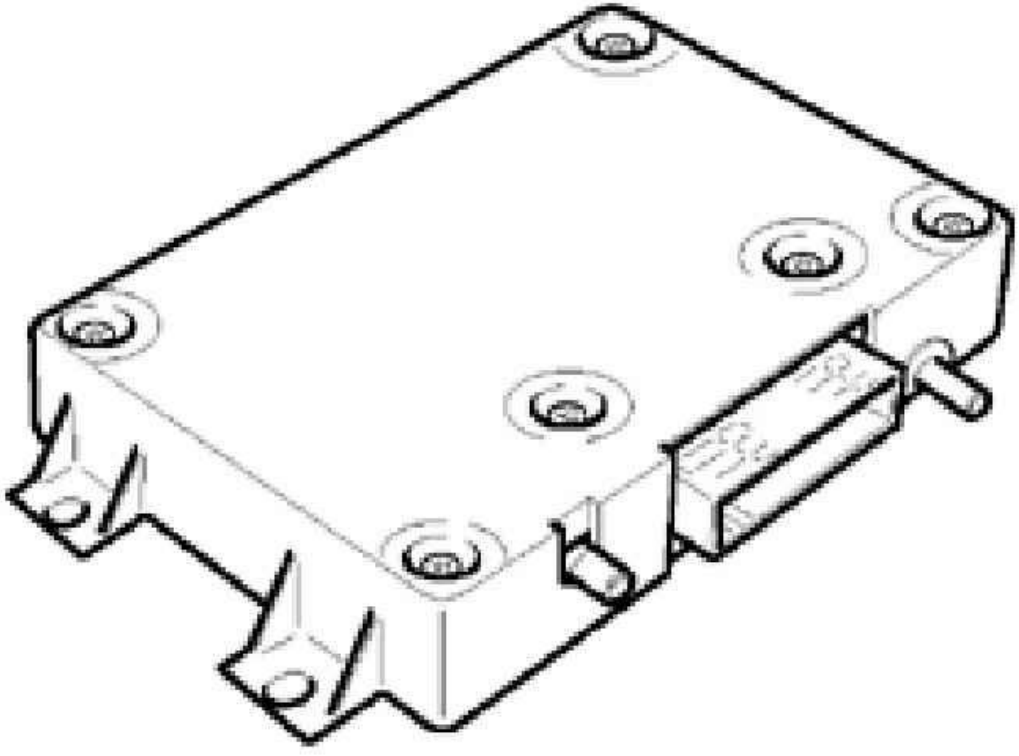

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Fig. 83: Connecting VAG1598/22 (Or 1598/31) Test Box To ECM Wiring Harness
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check wiring for open circuit between Test Box and harness connector using Wiring diagram.

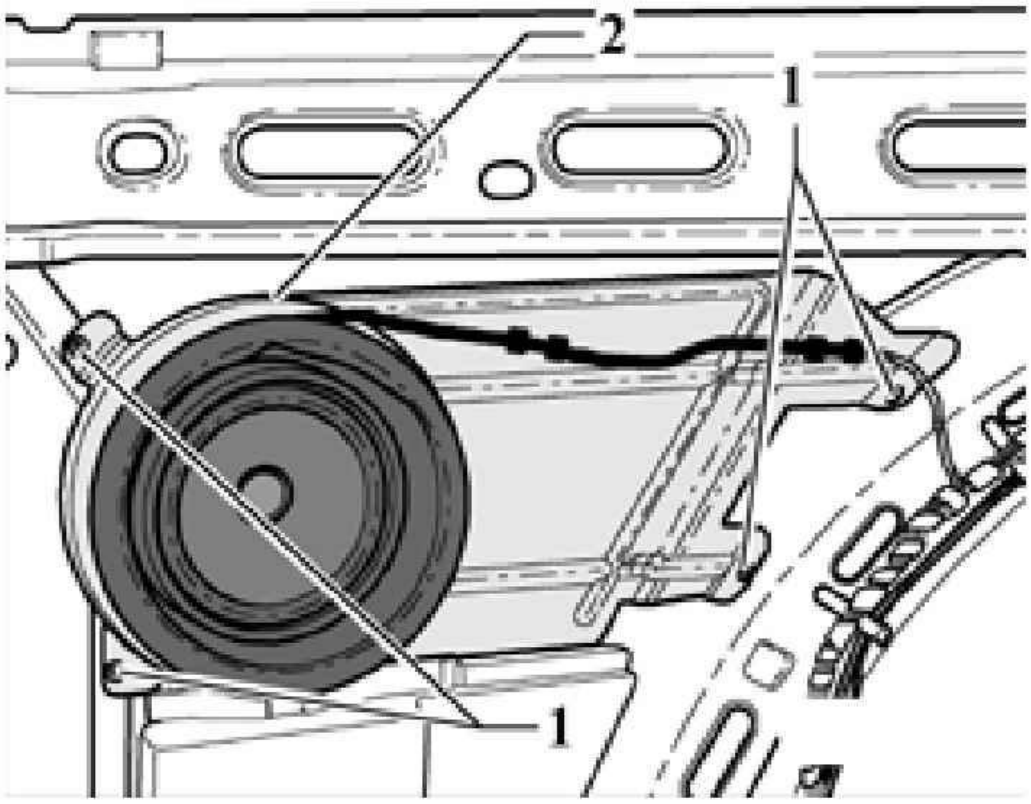


Fig. 84: Identifying 10-Pin Harness Connector Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Up to MY 1999

- Terminal 7 + socket 53
- Terminal 4 + socket 76

From MY 2000

- Terminal 7 + socket 111

- Terminal 4 + socket 103
- Wire resistance: 1.5 ohm maximum
- Check wires for short to one another, to Ground and to Battery +
- Specification: INFINITY ohm

If wiring OK:

- Replace Engine Control Module -J248-. See **Engine Control Module (ECM), replacing** .
- Display the Readiness code. See **READINESS CODE, DISPLAYING** .

If DTC memory was erased:

- Set the readiness code. See **READINESS CODE, SETTING** .

Modulating piston displacement sensor -G149- and quantity adjuster -N146-, checking

The quantity adjuster -N146- is an electro-magnetic swivel type positioner, controlled by the ECM via regulated duty cycle (ON-OFF ratio). The eccentric shaft on -N146- moves the Modulating piston on the high pressure piston thereby regulating the quantity of fuel injected.

The Modulating piston displacement sensor -G149- communicates the position of -N146- to the ECM thereby determining the quantity of fuel to be injected.

Special tools

- VAG1551/1552 Scan Tool using VAG1551/3 Adapter cable
- VAG1598/22 Test Box (MY 1999)
- VAG1598/31 Test Box (from MY 2000)
- Fluke 83 multimeter
- VW 1594 Adapter kit
- Wiring diagram

Test sequence

- Connect VAG1551/1552 Scan Tool. See **VAG1551/1552 SCAN TOOL, CONNECTING** .
- Start engine and let idle.
- Press -0- and -1- buttons to select Address word 01: "Engine electronics"

Display will appear as shown (example only):

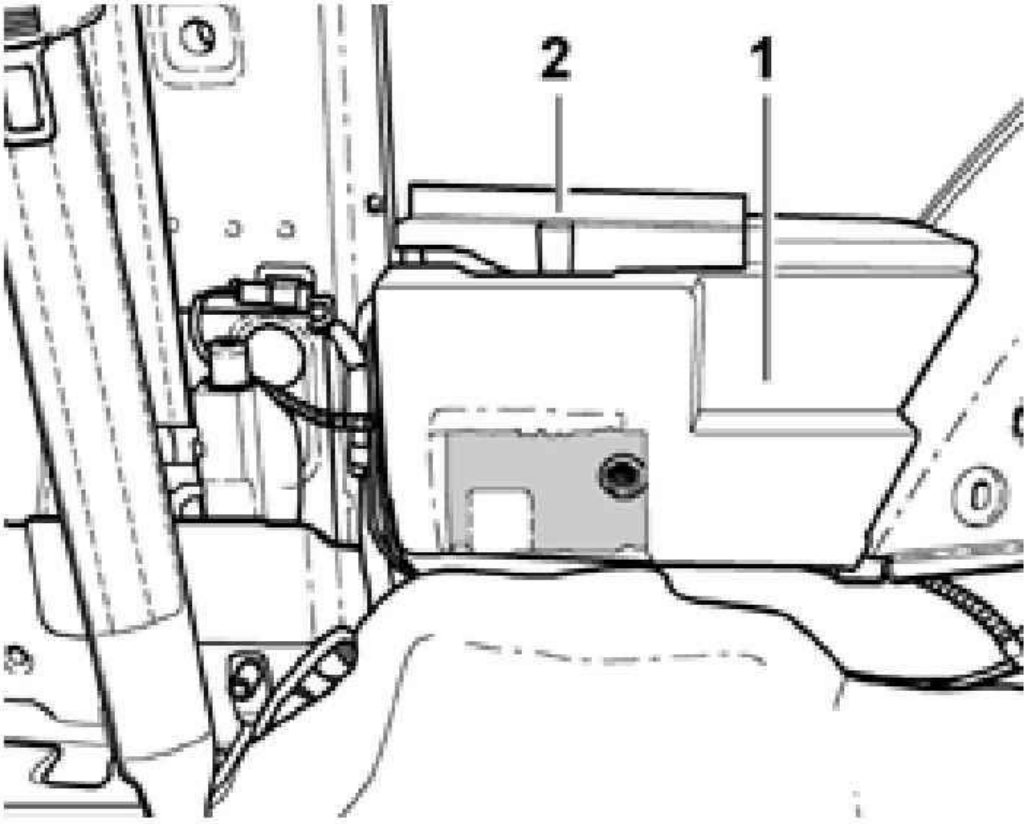


Fig. 85: Scan Tool Display - Modulating Piston Displacement Sensor & Quantity Adjuster (1 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press --> button.

Display will appear as shown:

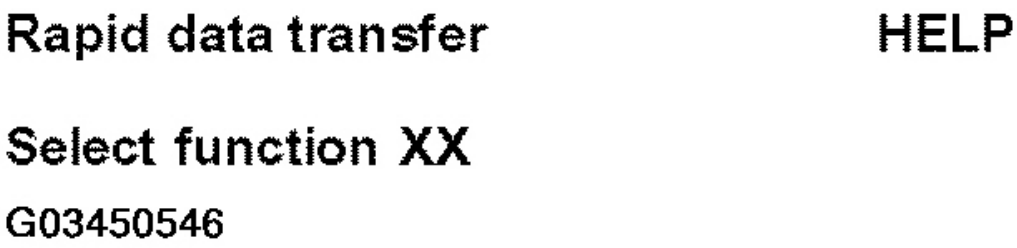


Fig. 86: Scan Tool Display - Modulating Piston Displacement Sensor & Quantity Adjuster (2 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -8- buttons to select Function 08: "Read measuring value block".
- Press -Q- button to enter input.

Display will appear as shown:

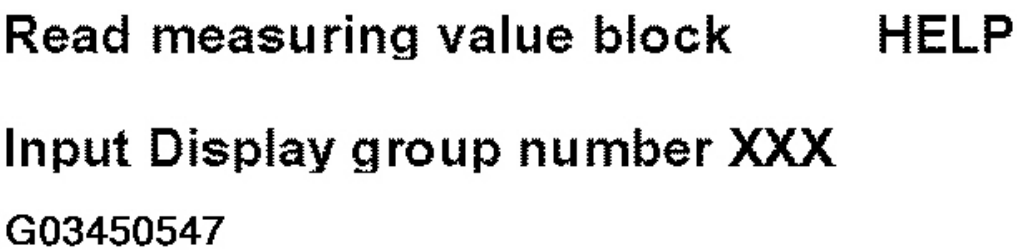


Fig. 87: Scan Tool Display - Modulating Piston Displacement Sensor & Quantity Adjuster (3 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press buttons -0-, -0- and -1- to select "Display group 1".
- Press -Q- button to enter input.

Display will appear as shown:

Fig. 88: Scan Tool Display - Modulating Piston Displacement Sensor & Quantity Adjuster (4 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check Engine Coolant Temperature value in Display zone 4.
- Specification: 85 °C minimum
- Continue with check only when temperature speck. is obtained.
- Check value in Display zone 3 (Voltage from Modulating piston movement).

- Check Modulating piston displacement sensor -G149- Voltage supply value in Display zone 3.

Fig. 89: Scan Tool Display - Modulating Piston Displacement Sensor & Quantity Adjuster (5 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Specification: 1.450 to 2.000 Volts

If specification not obtained:

- Check Modulating piston displacement sensor -G149- and quantity adjuster as described in following:

Modulating piston displacement sensor -G149-, checking

- Press --> button.

Display will appear as shown:

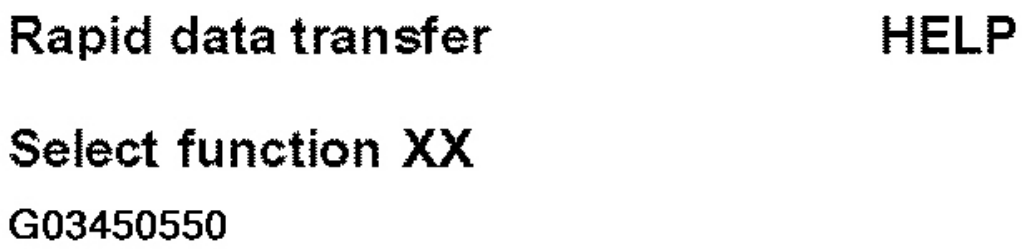


Fig. 90: Scan Tool Display - Modulating Piston Displacement Sensor
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -6- buttons to select Function 06: "End output".
- Press -Q- button to enter input.
- Switch OFF ignition.
- Disconnect 10-pin Fuel Temperature sensor harness connector (connection to Diesel injection pump metering control).

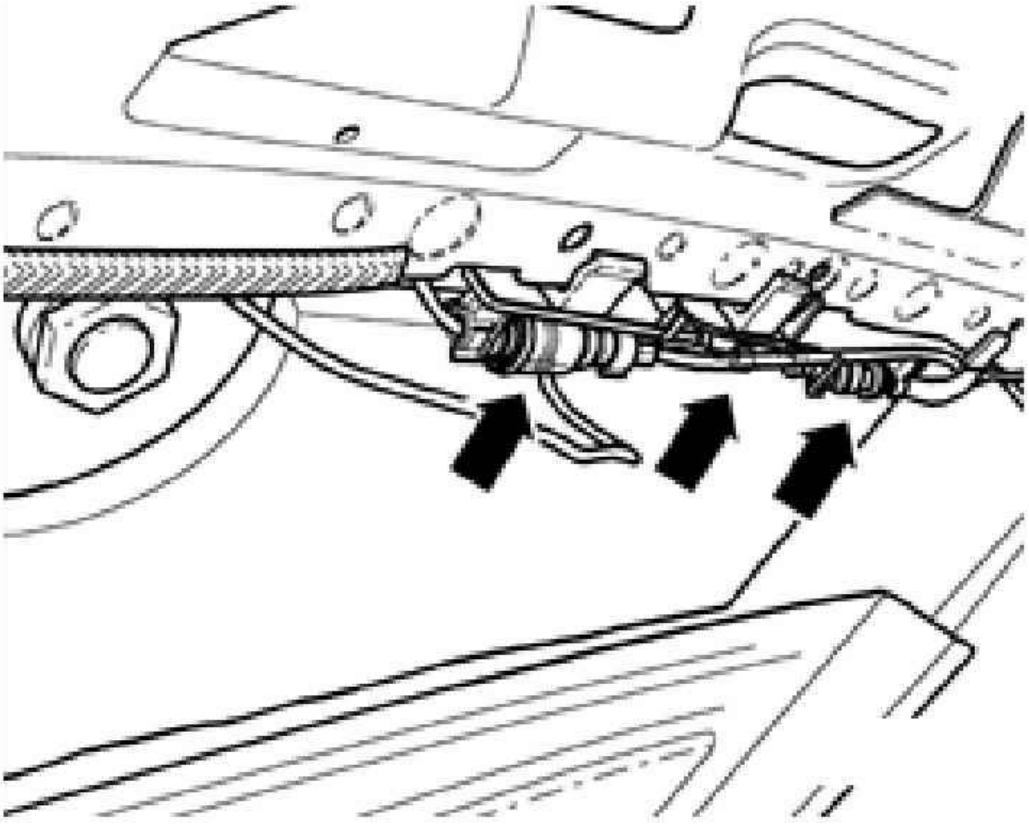


Fig. 91: Identifying 10-Pin Fuel Temperature Sensor Connector Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Switch Fluke 83 multimeter to resistance range.
- Measure resistance between connector terminals: 1 + 2 and 2 + 3.
- Specification: 4.9 to 7.5ohm

If specification not obtained:

- Replace Diesel injection pump. See **DIESEL INJECTION PUMP, REMOVING AND INSTALLING** .
- Display the Readiness code. See **READINESS CODE, DISPLAYING** .

If DTC memory was erased:

- Set the readiness code. See **READINESS CODE, SETTING** .

If specification obtained:

- Connect VAG1598/22 (or 1598/31) Test Box to ECM wiring harness.

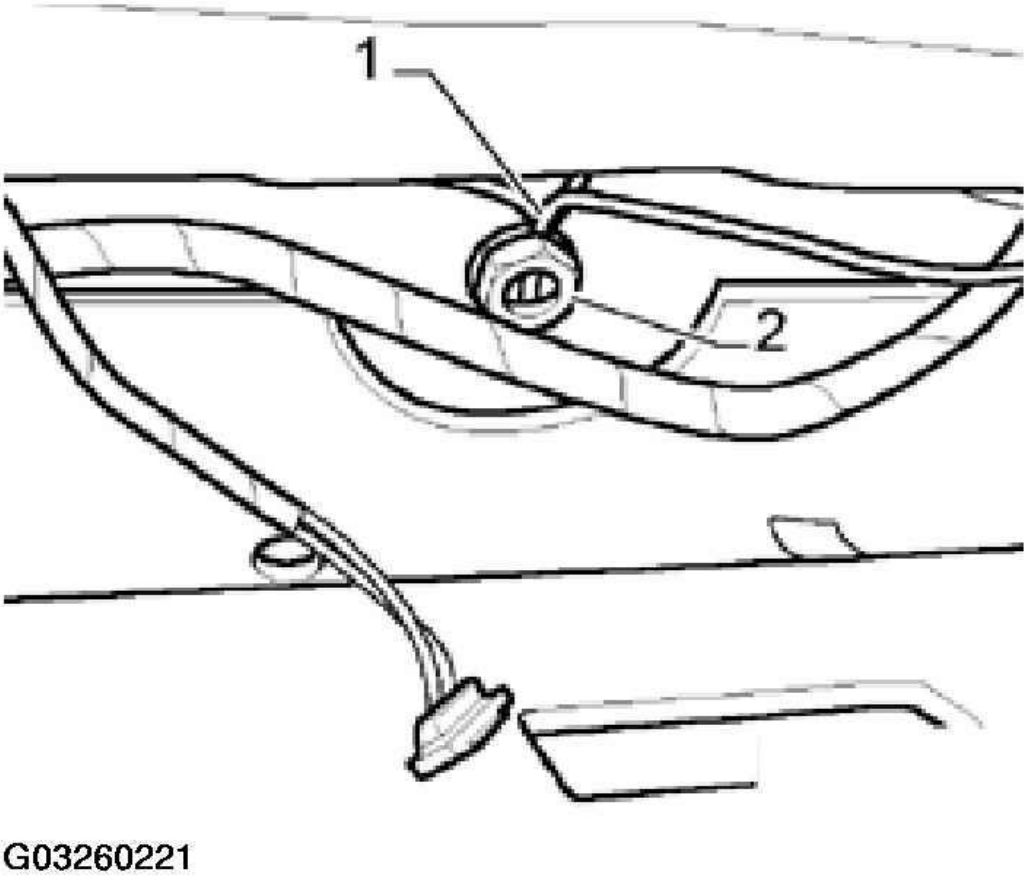


Fig. 92: Connecting VAG1598/22 (Or 1598/31) Test Box To ECM Wiring Harness
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check wiring for open circuit between Test Box and harness connector using Wiring diagram.

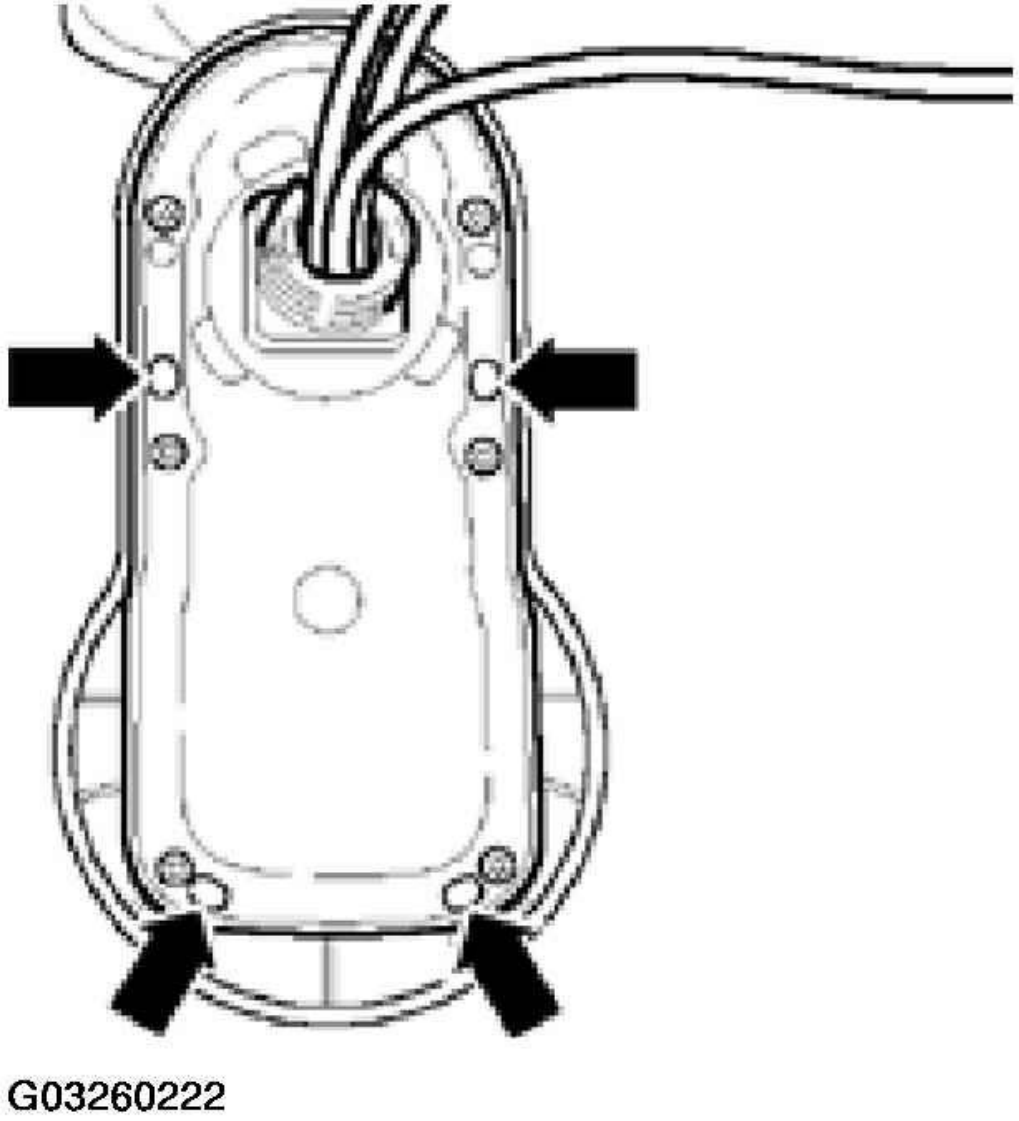


Fig. 93: Identifying 10-Pin Harness Connector Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Up to MY 1999

- Terminal 1 + socket 56
- Terminal 2 + socket 57
- Terminal 3 + socket 64

From MY 2000

- Terminal 1 + socket 108
- Terminal 2 + socket 106
- Terminal 3 + socket 99
- Wire resistance: 1.5ohm maximum
- Check wires for shorting to: one another, Ground and Battery +
- Specification: INFINITY ohm

If wiring OK:

- Replace Engine Control Module -J248-. See **Engine Control Module (ECM), replacing** .
- Display the Readiness code. See **READINESS CODE, DISPLAYING** .

If DTC memory was erased:

- Set the readiness code. See **READINESS CODE, SETTING** .

Quantity adjuster -N146-, checking

- Press --> button.

Display will appear as shown:

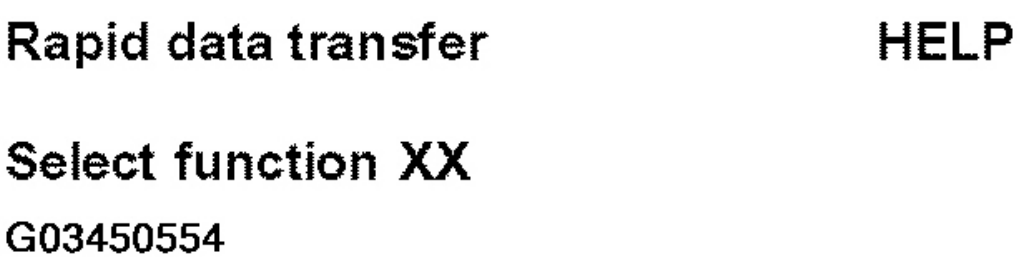
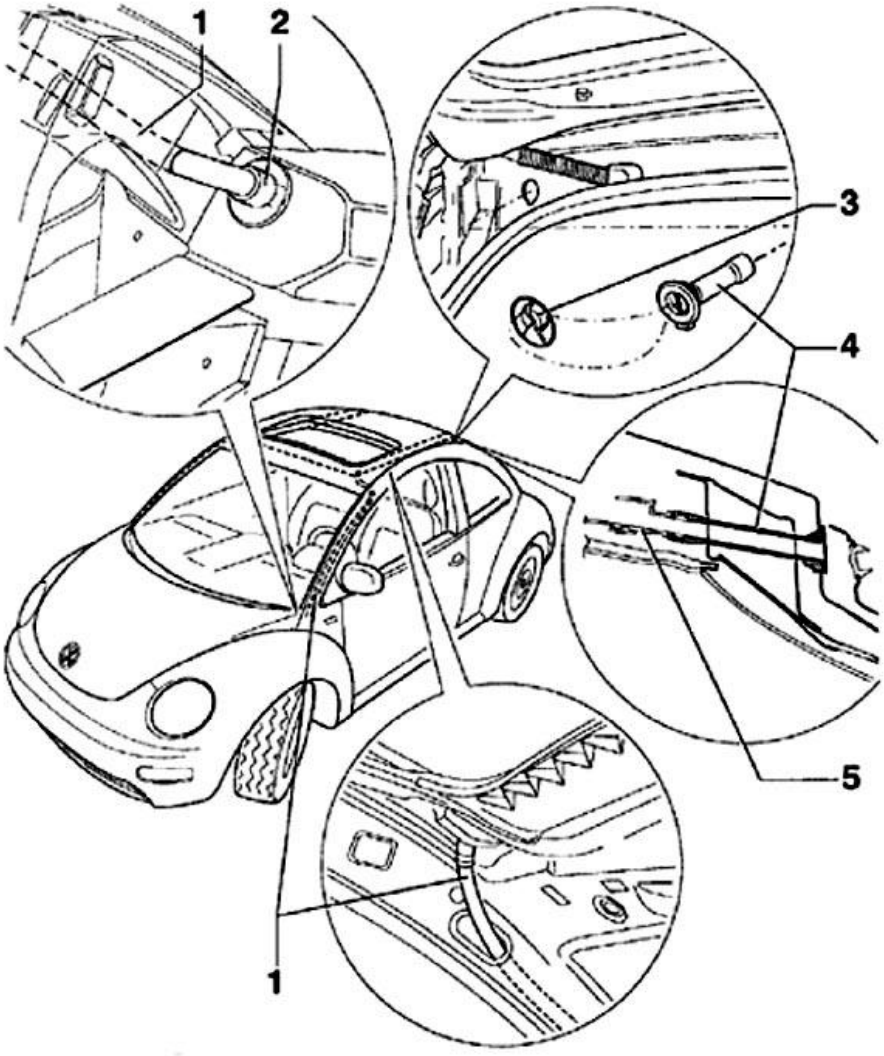


Fig. 94: Scan Tool Display - Quantity Adjuster
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -6- buttons to select Function 06: "End output".
- Press -Q- button to enter input.

- Switch OFF ignition.
- Disconnect 10-pin Fuel Temperature sensor harness connector (connection to Diesel injection pump metering control).



1 - Front water drain hoses.

2 - Front water drain valve.

3 - Cover.

4 - Water drain hose with valve.

5 - Carrier unit.

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Fig. 95: Identifying 10-Pin Connector Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Measure resistance between connector terminals 5 + 6.
- Specification: 0.5 to 2.5 ohm

If specification not obtained:

- Replace Diesel injection pump. See **DIESEL INJECTION PUMP, REMOVING AND INSTALLING** .
- Display the Readiness code. See **READINESS CODE, DISPLAYING** .

If DTC memory was erased:

- Set the readiness code. See **READINESS CODE, SETTING** .

If specification obtained:

- Connect VAG1598/22 (or 1598/31) Test Box to ECM wiring harness.

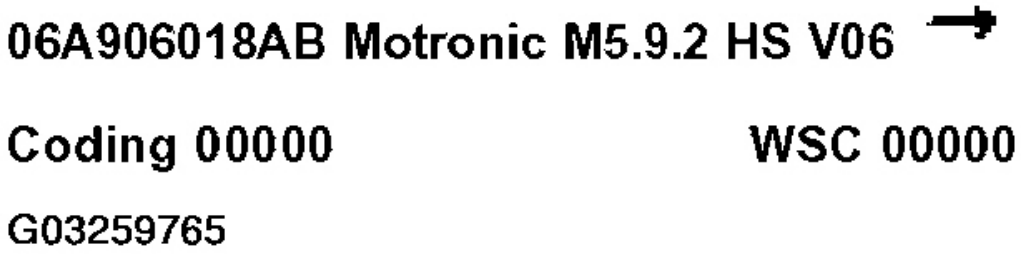


Fig. 96: Connecting VAG1598/22 (Or 1598/31) Test Box To ECM Wiring Harness
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check wiring for open circuit between Test Box and harness connector using Wiring diagram.

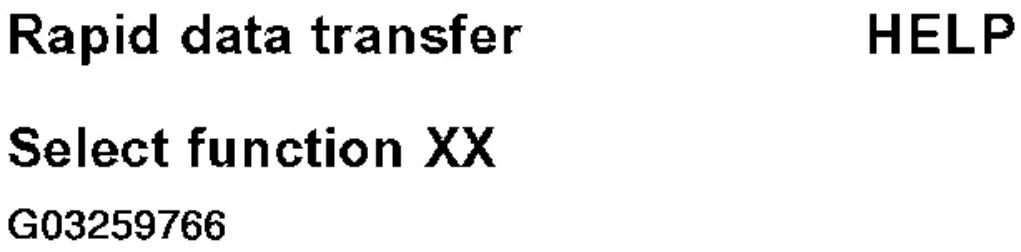


Fig. 97: Identifying 10-Pin Harness Connector Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Up to MY 1999

- Terminal 5 + sockets 2 and 28
- Terminal 6 + sockets 59, 66 and 80

From MY 2000

- Terminal 5 + sockets 1 and 2
- Terminal 6 + sockets 116 and 121
- Wire resistance: 1.5ohm maximum
- Check wires for shorting to: one another, Ground and Battery +.
- Specification: INFINITY ohm

If wiring OK:

- Replace Engine Control Module -J248-. See **Engine Control Module (ECM), replacing** .
- Display the Readiness code. See **READINESS CODE, DISPLAYING** .

If DTC memory was erased:

- Set the readiness code. See **READINESS CODE, SETTING** .

Needle Lift Sensor -G80-, checking

The Needle Lift Sensor -G80- signal determines the start of injection. If -G80- fails, start of injection switches to open-loop control (based on engine speed and load). During normal operation, start of injection is controlled

via closed-loop function (based on engine speed, load and temperature).

Special tools

- VAG1598/22 Test Box (MY 1999)
- VAG1598/31 Test Box (from MY 2000)
- Fluke 83 multimeter
- VW 1594 Adapter kit
- Wiring diagram

Test sequence

- Switch OFF ignition.
- Disconnect Needle Lift Sensor -G80- harness connector. See **DIESEL INJECTION SYSTEM, COMPONENT LOCATIONS OVERVIEW** .
- Measure resistance between sensor terminals.

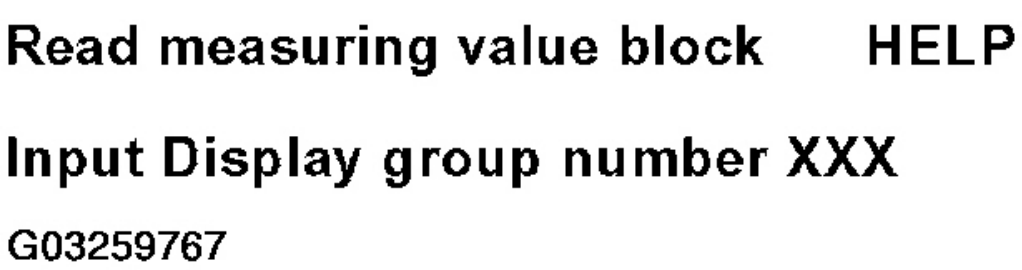


Fig. 98: Identifying Needle Lift Sensor Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Specification: 80 to 120 ohm

If specification not obtained:

- Replace cyl. 3 fuel injector complete with -G80-. See item 13 .
- Display the Readiness code. See **READINESS CODE, DISPLAYING** .

If DTC memory was erased:

- Set the readiness code. See **READINESS CODE, SETTING** .

If specification obtained:

- Connect VAG1598/22 (or 1598/31) Test Box to ECM wiring harness.

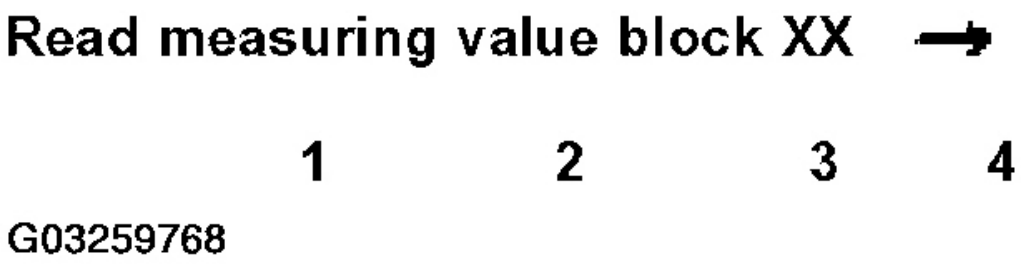


Fig. 99: Connecting VAG1598/22 (Or 1598/31) Test Box To ECM Wiring Harness
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check wiring for open circuit between Test Box and harness connector using Wiring diagram.

Fig. 100: Identifying Needle Lift Sensor Harness Connector Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Up to MY 1999

- Terminal 1 + socket 62
- Terminal 2 + socket 55

From MY 2000

- Terminal 1 + socket 109
- Terminal 2 + socket 101
- Wire resistance: 1.5ohm maximum
- Check wires for shorting to: one another, Ground and Battery +
- Specification: INFINITY ohm

If wiring OK:

- Replace ECM -J248-. See **Engine Control Module (ECM), replacing** .
- Display the Readiness code. See **READINESS CODE, DISPLAYING** .

If DTC memory was erased:

- Set the readiness code. See **READINESS CODE, SETTING** .

Diesel injection timing control range, checking

The EGR function occurs in Function 04 (basic setting). By using this procedure, the EGR valve is cycled every 10 seconds, so that in the measurement block 003 the extreme values can be read for EGR (Mass Air Flow sensor) in channel 3.

Special tools

- VAG1551/1552 Scan Tool using VAG1551/3 Adapter cable
- VAG1598/22 Test Box (MY 1999)
- VAG1598/31 Test Box (from MY 2000)
- Fluke 83 multimeter
- VW 1594 Adapter kit
- Wiring diagram

Test sequence

- Connect VAG1551/1552 Scan Tool (See **VAG1551/1552 SCAN TOOL, CONNECTING**) and start engine and let idle.
- Press -0- and -1- buttons to select Address word 01: "Engine electronics"

Display will appear as shown (example only):

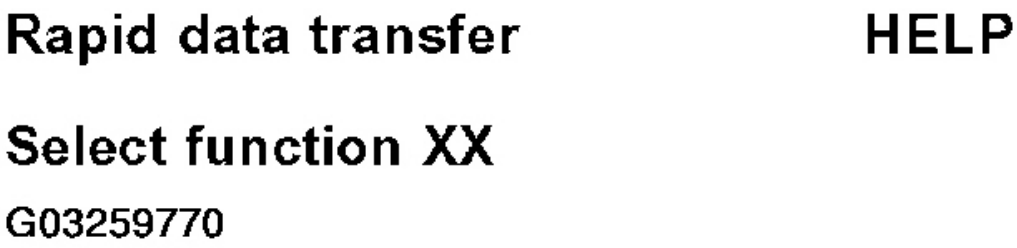


Fig. 101: Scan Tool Display - Diesel Injection Timing Control Range (1 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press --> button.

Display will appear as shown:

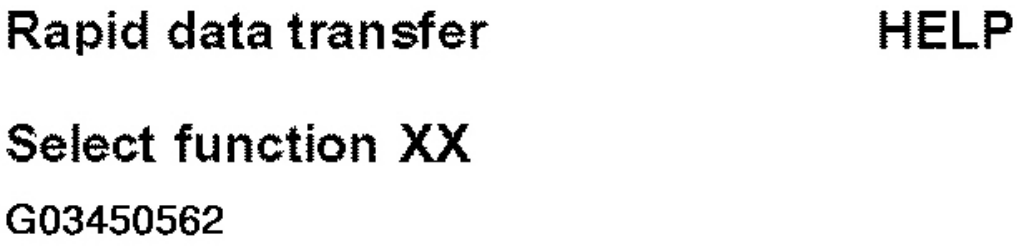


Fig. 102: Scan Tool Display - Diesel Injection Timing Control Range (2 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -4- buttons to select Function 04: "Basic setting".
- Press -Q- button to enter input.

Display will appear as shown:

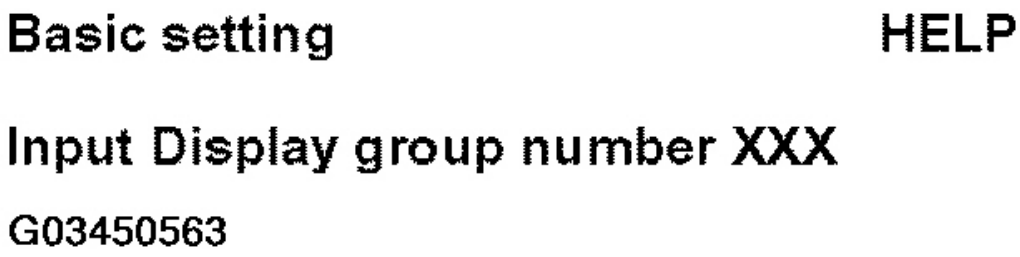


Fig. 103: Scan Tool Display - Diesel Injection Timing Control Range (3 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press buttons -0-, -0- and -4- to select "Display group 4".

Display will appear as shown:

Fig. 104: Scan Tool Display - Diesel Injection Timing Control Range (4 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Specification (Display zone 3): 7.0 to 9.0° BTDC

After approx. 10 seconds, the Diesel injection adjuster is moved into the retarded position.

Display will appear as shown:

Fig. 105: Scan Tool Display - Diesel Injection Timing Control Range (5 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Specification (Display zone 3): 3.0 to 5.0° BTDC

If specifications not obtained:

- Check Cold Start injector as follows:
- Press --> button.
- Press -0- and -6- buttons to select Function 06: "End output".
- Press -Q- button to enter input.
- Switch OFF ignition.
- Disconnect harness connector from Diesel injection pump. See **DIESEL INJECTION SYSTEM, COMPONENT LOCATIONS OVERVIEW** .
- Measure resistance between connector terminals 9 + 10.
  - Specification: 12 to 20 ohm

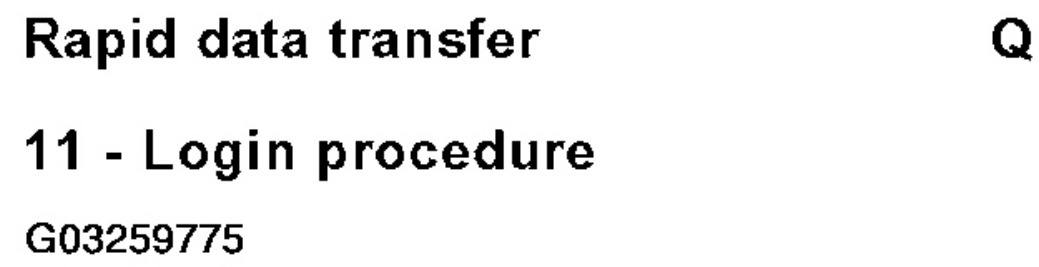


Fig. 106: Identifying 10-Pin Connector Terminals

Courtesy of VOLKSWAGEN OF AMERICA, INC.

If specification not obtained:

- Replace Cold Start injector -N108-. See **INTAKE MANIFOLD CHANGE-OVER VALVE, SERVICING** .
- Display the Readiness code. See **READINESS CODE, DISPLAYING** .

If DTC memory was erased:

- Set the readiness code. See **READINESS CODE, SETTING** .

If specification obtained:

- Connect VAG1598/22 (or 1598/31) Test Box to ECM wiring harness.

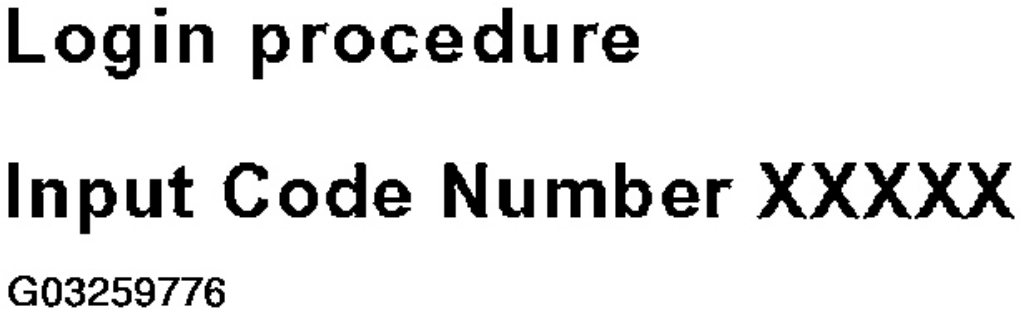


Fig. 107: Connecting VAG1598/22 (Or 1598/31) Test Box To ECM Wiring Harness
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check wiring for open circuit between Test Box and 10-pin harness connector using Wiring diagram.

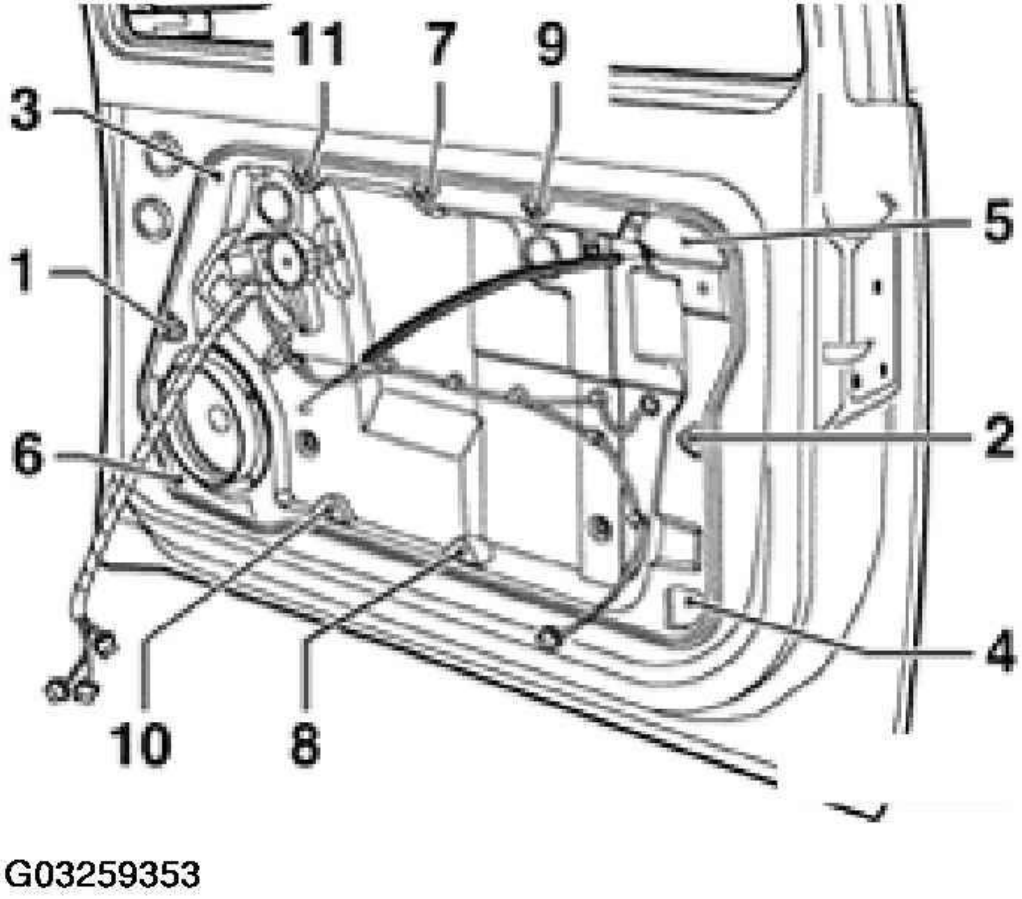


Fig. 108: Identifying 10-Pin Harness Connector Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Up to MY 1999

- Terminal 9 + socket 79
- Terminal 10 + sockets 2 + 28

From MY 2000

- Terminal 9 + socket 114
- Terminal 10 + sockets 1 + 2

- Wire resistance: 1.5ohm maximum

- Check wires for shorting to: one another, Ground and Battery +
- Specification: INFINITY ohm

If wiring OK

- Replace Engine Control Module -J248-. See **Engine Control Module (ECM), replacing** .
- Display the Readiness code. See **READINESS CODE, DISPLAYING** .

If DTC memory was erased:

- Set the readiness code. See **READINESS CODE, SETTING** .

Boost pressure control, checking

Special tools

- VAG1551/1552 Scan Tool using VAG1551/3 Adapter cable
- VAG1598/22 Test Box (MY 1999)
- VAG1598/31 Test Box (from MY 2000)
- Fluke 83 multimeter
- VW 1594 Adapter kit
- Wiring diagram

NOTE: To check Boost pressure control it is essential to first know the actual Boost pressure value independent of the Boost pressure control limits.

See **CHARGE AIR PRESSURE SYSTEM, CHECKING** .

Test requirements

- Fuse 34 OK

Test sequence

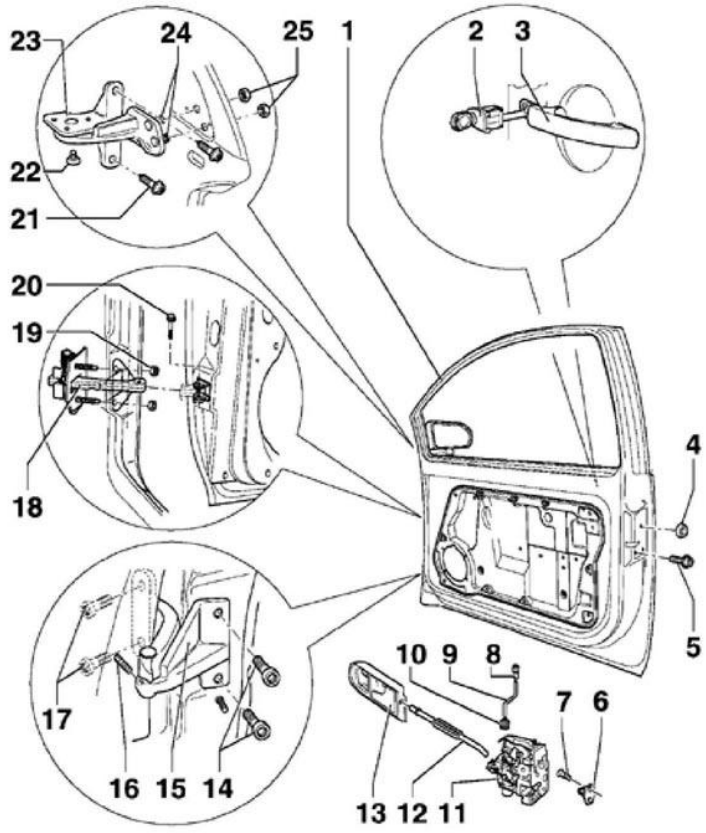
- Boost pressure using VAG1551/1552 Scan Tool during a test drive.

WARNING: For safe operation, use a second technician to operate test equipment and take readings from back seat, during test drive.

- Make sure Wastegate Bypass Regulator valve - N75- harness connector is connected.
- Connect VAG1551/1552 Scan Tool. See **VAG1551/1552 SCAN TOOL, CONNECTING** .
- Start engine and let idle.

- Press -0- and -1- buttons to select Address word 01: "Engine electronics"

  Display will appear as shown (example only):



1 - Door
2 - Lock cylinder housing
3 - Door handle with base
4 - Cover cap
5 - Bolt/screw
6 - Lock plate
7 - Bolt/screw
8 - Locking button
9 - Locking button
10 - Boot
11 - Door lock
12 - Bowden cable
13 - Interior release handle
14 - Bolt/screw
15 - Door hinge
16 - Grub screw
17 - Bolt/screw
18 - Door arrester
19 - Nut
20 - Pin
21 - Bolt/screw
22 - Bolt/screw
23 - Door hinge
24 - Pin
25 - Nut

G03259117

Fig. 109: Scan Tool Display - Boost Pressure Control (1 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press --> button.

Display will appear as shown:

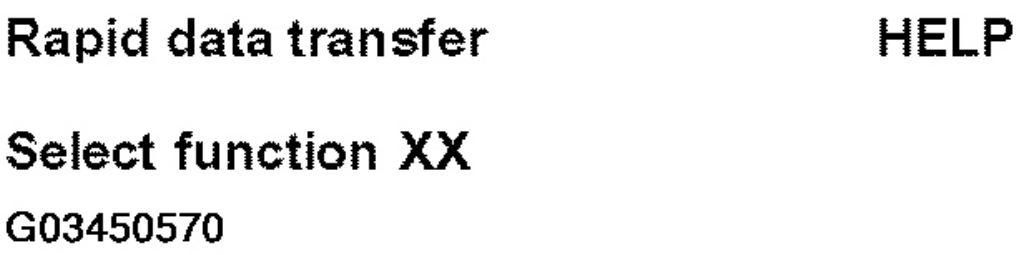


Fig. 110: Scan Tool Display - Boost Pressure Control (2 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -8- buttons to select Function 08: "Read measuring value block".
- Press -Q- button to enter input.

  Display will appear as shown:

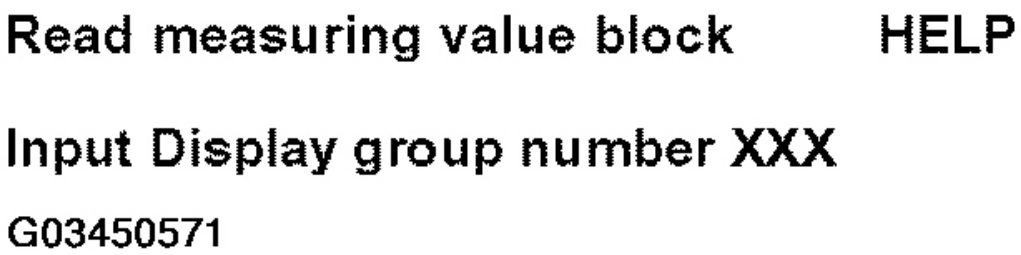


Fig. 111: Scan Tool Display - Boost Pressure Control (3 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0-, -1- and -1- buttons to select "Display group 11"

- Press -Q- button to enter input.

  Display will appear as shown

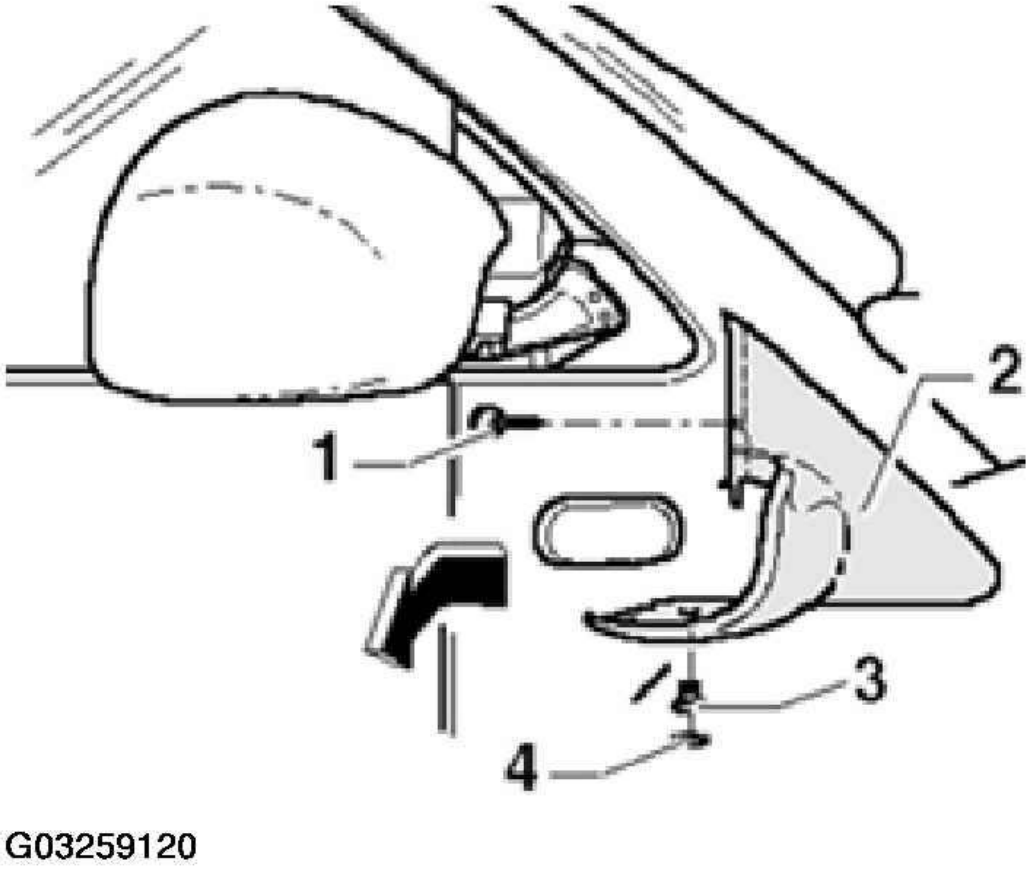


Fig. 112: Scan Tool Display - Boost Pressure Control (4 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Accelerate vehicle in 3rd gear from about 1500 RPM under Wide Open Throttle.
- Press PRINT button on VAG1551 at about 3000 RPM.
- Specification on VAG1551: 1720 to 2300 mbar (Display zone 3)

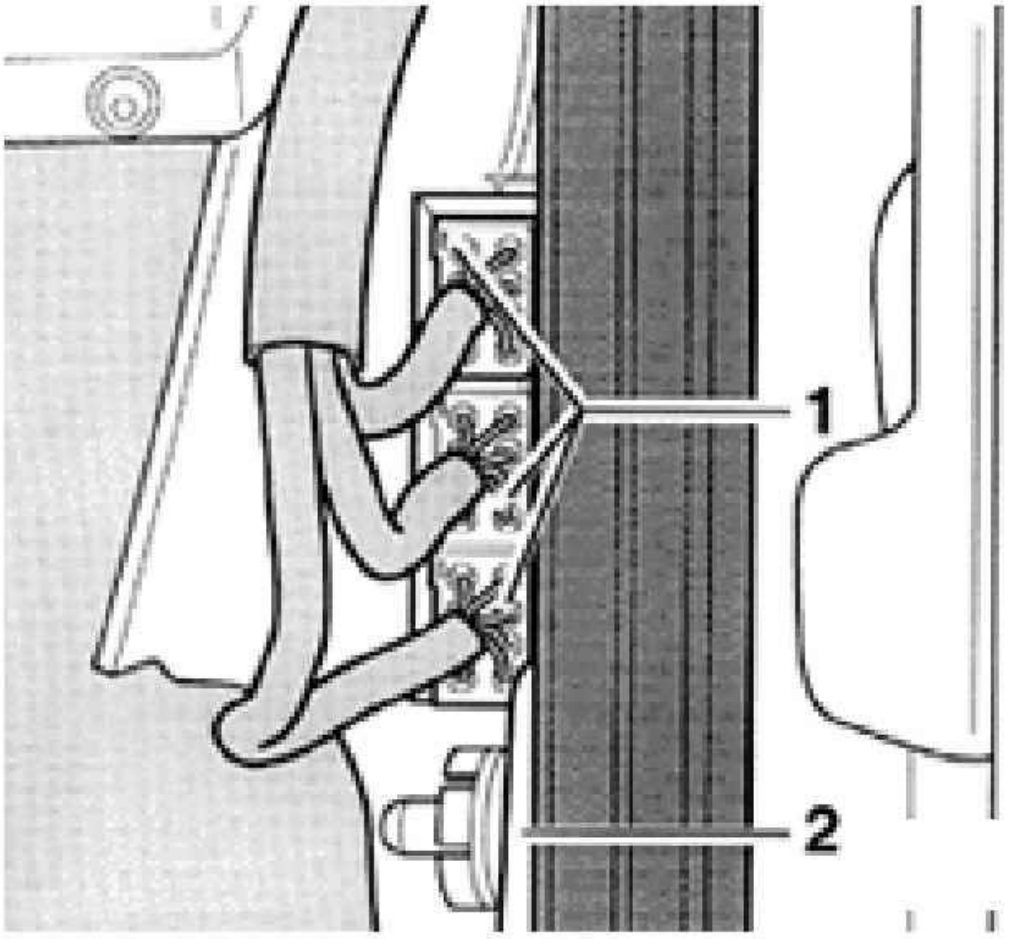


Fig. 113: Scan Tool Display - Boost Pressure Control (5 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

If measured Boost pressure is too low

- Check -N75- as follows:

Wastegate bypass regulator valve -N75-, electrically checking

- Switch OFF ignition.
- Disconnect -N75- harness connector. See **DIESEL INJECTION SYSTEM, COMPONENT LOCATIONS OVERVIEW** .

- Switch Fluke 83 multimeter to resistance range.
- Measure resistance between -N75- terminals using multimeter.

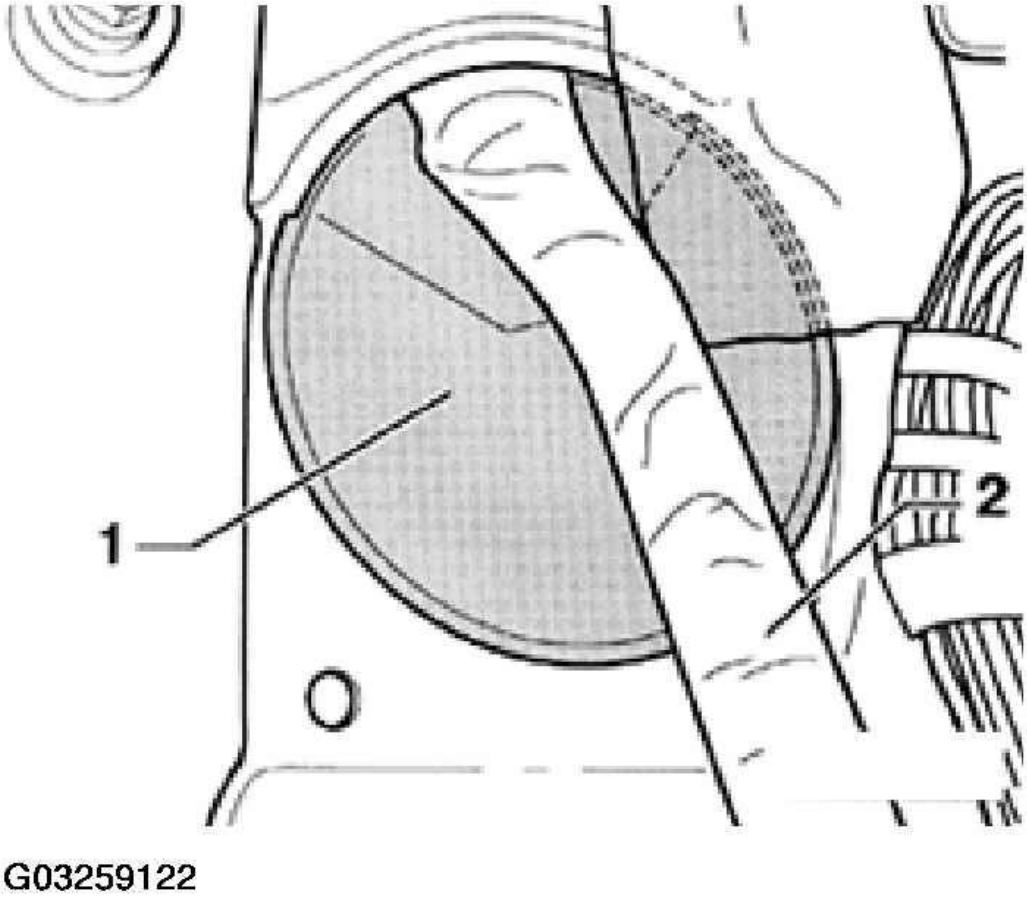


Fig. 114: Measuring Resistance Between Wastegate Bypass Regulator Valve -N75- Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Specification: 14 to 20 ohm

If specification not obtained:

- Replace Wastegate Bypass Regulator valve - N75-.
- Display the Readiness code. See **READINESS CODE, DISPLAYING** .

If DTC memory was erased:

- Set the readiness code. See **READINESS CODE, SETTING** .

Wastegate Bypass regulator valve -N75- Voltage supply, checking

- Switch OFF ignition.
- Disconnect harness connector off valve. See **DIESEL INJECTION SYSTEM, COMPONENT LOCATIONS OVERVIEW** .
- Connect Fluke 83 multimeter between terminal 1 and Ground using jumper wires from VW 1594 Adapter kit.

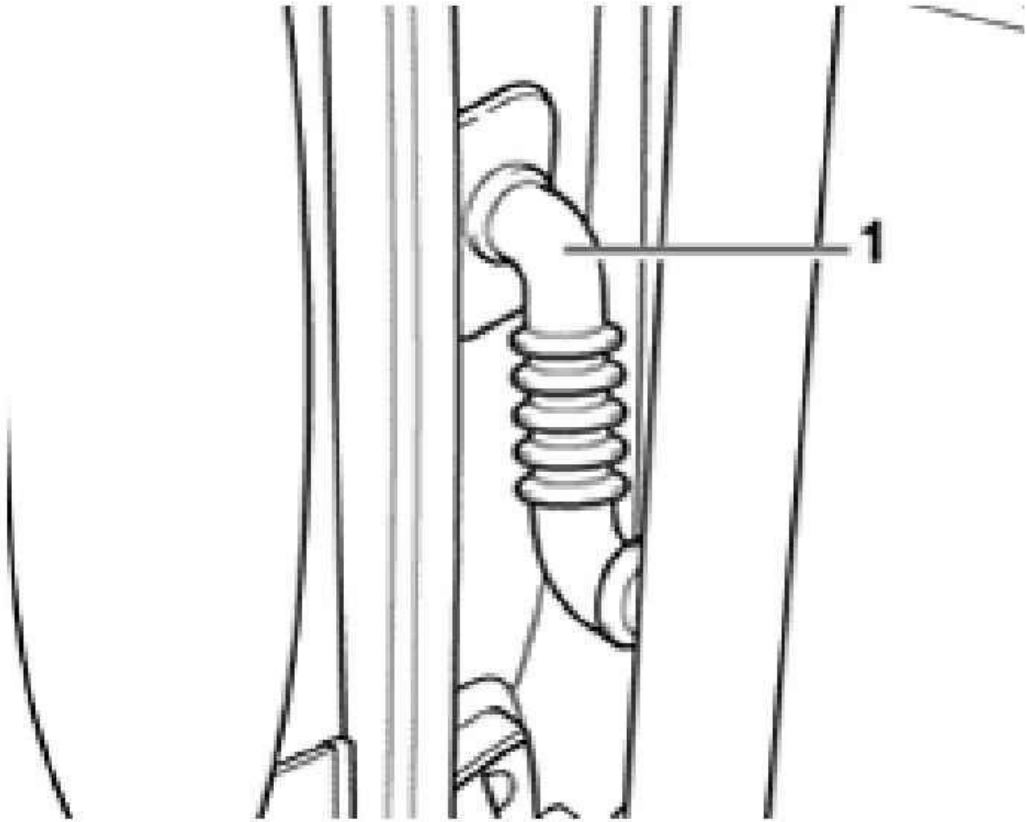


Fig. 115: Identifying Wastegate Bypass Regulator Valve -N75- Harness Connector Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Switch Fluke 83 multimeter to 20 Volt range.
- Switch ON ignition.

- Specification: approx. battery Voltage

If specification not obtained:

- Check wiring/connections to -N75-.
- Switch OFF ignition.
- Connect VAG1598/22 (or 1598/31) Test Box to ECM wiring harness.

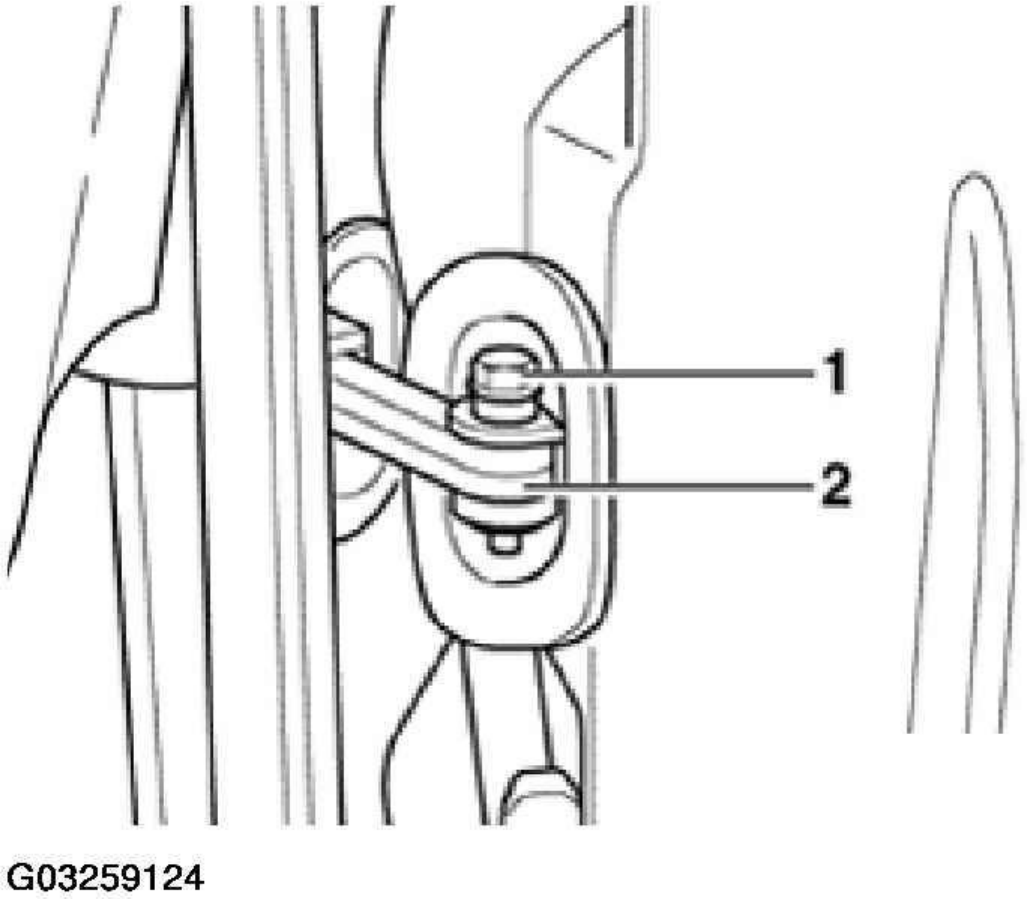


Fig. 116: Connecting VAG1598/22 (Or 1598/31) Test Box To ECM Wiring Harness
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check wiring for open circuit between Test Box and harness connector using Wiring diagram.

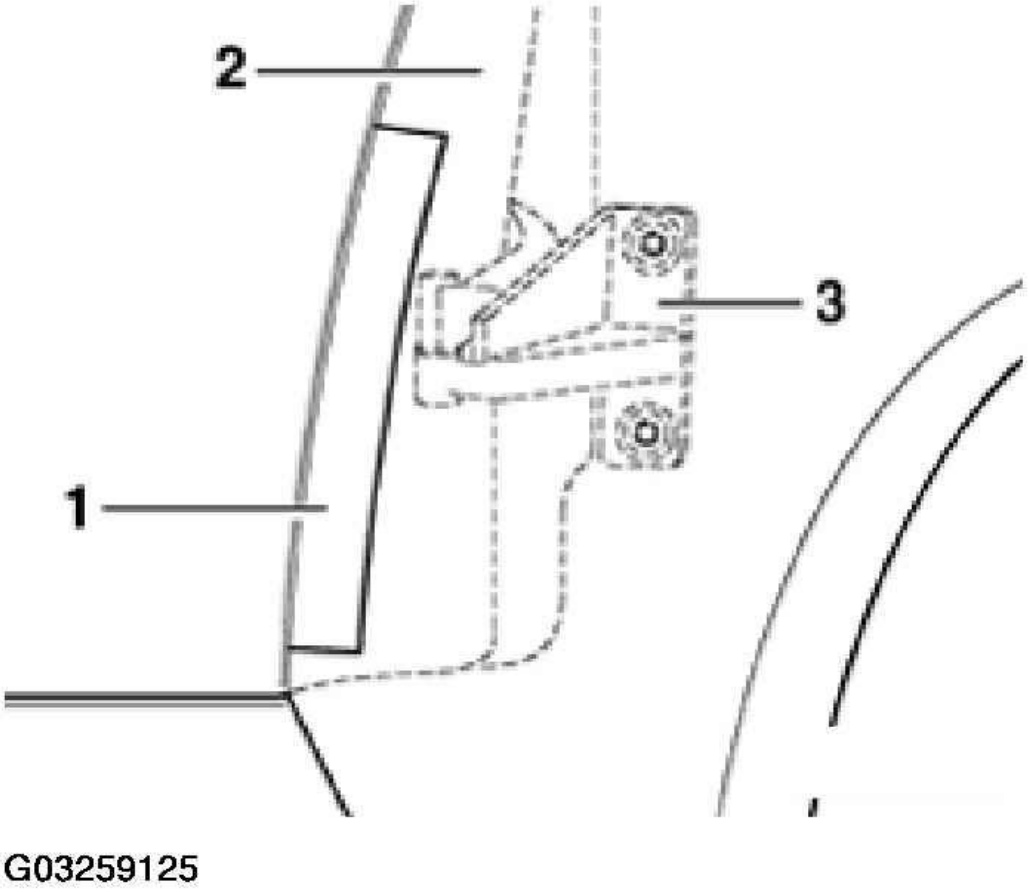


Fig. 117: Identifying Wastegate Bypass Regulator Valve -N75- Harness Connector Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Up to MY 1999

- Terminal 1 + socket 28
- Terminal 2 + socket 15

From MY 2000

- Terminal 1 + socket 2
- Terminal 2 + socket 62

- Wire resistance: 1.5 ohm maximum

- Check wires for shorting to: one another, Ground and Battery +.
- Specification: INFINITY ohm
- Correct any open/short circuit as necessary.

If no open or short circuits exist:

- Replace Engine Control Module.
- Display the Readiness code. See **READINESS CODE, DISPLAYING** .

If DTC memory was erased:

- Set the readiness code. See **READINESS CODE, SETTING** .

Mass Air Flow (MAF) Sensor -G70-, checking

ECM uses MAF Sensor -G70- signal to calculate injection quantity and for regulating EGR. The smaller the -G70- signal; the smaller the quantity of injected fuel.

Special tools

- VAG1551/1552 Scan Tool using VAG1551/3 Adapter cable
- VAG1598/22 Test Box (MY 1999)
- VAG1598/31 Test Box (from MY 2000)
- Fluke 83 multimeter
- VW 1594 Adapter kit
- Wiring diagram

> **WARNING: For safe operation, use a second technician to operate test equipment and take readings from back seat, during test drive.**

Test sequence

- Connect VAG1551/1552 Scan Tool. See **VAG1551/1552 SCAN TOOL, CONNECTING** and start engine and let idle.
- Press -0- and -1- buttons to select Address word 01: "Engine electronics"

Display will appear as shown (example only):

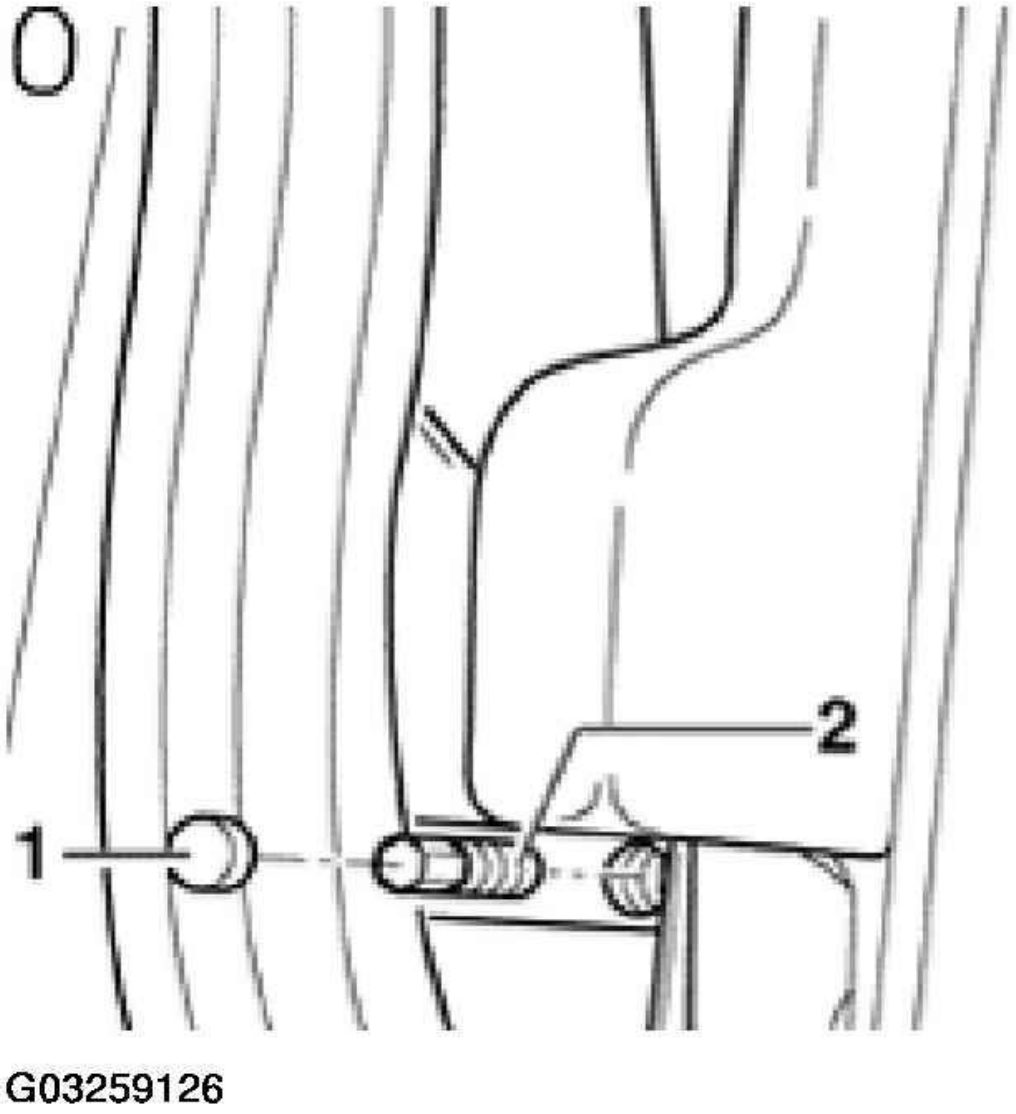


Fig. 118: Scan Tool Display - Mass Air Flow Sensor (1 Of 7)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press --> button.

Display will appear as shown:

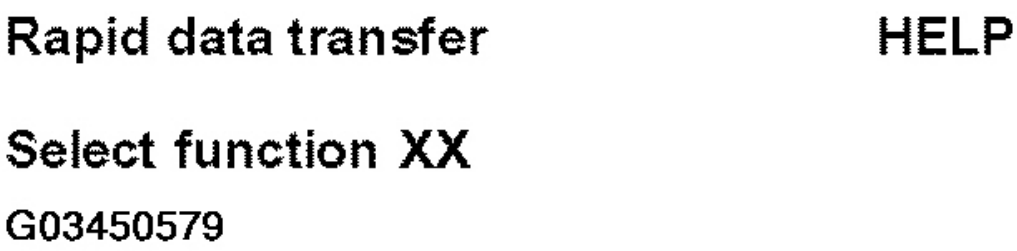


Fig. 119: Scan Tool Display - Mass Air Flow Sensor (2 Of 7)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -8- buttons to select Function 08: "Read measuring value block".
- Press -Q- button to enter input.

Display will appear as shown:

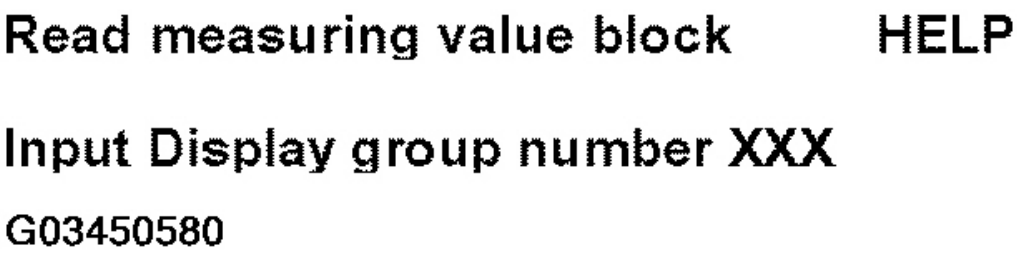


Fig. 120: Scan Tool Display - Mass Air Flow Sensor (3 Of 7)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0-, -1- and -0- buttons to select "Display group 10".
- Observe display in Display zone 1.
- Specified Value: 200 to 450 mg/H

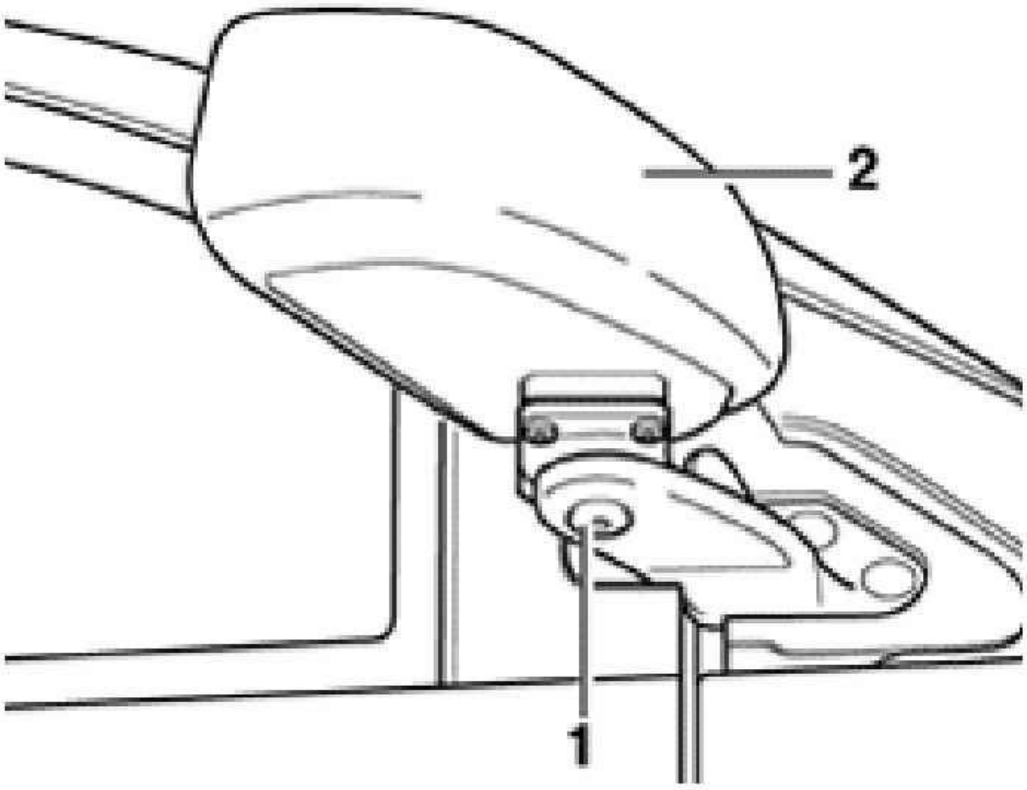


Fig. 121: Scan Tool Display - Mass Air Flow Sensor (4 Of 7)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

If specification not obtained:

- Check Exhaust Gas Recirculation system

See **EXHAUST GAS RECIRCULATION (EGR), CHECKING** .

If specification obtained:

- Accelerate vehicle in 3rd gear from about 1500 RPM under Wide Open Throttle (WOT).
- Press PRINT button on VAG1551 at approx. 3000 RPM.
- Specification in Display zone 4: 100% (Throttle position)

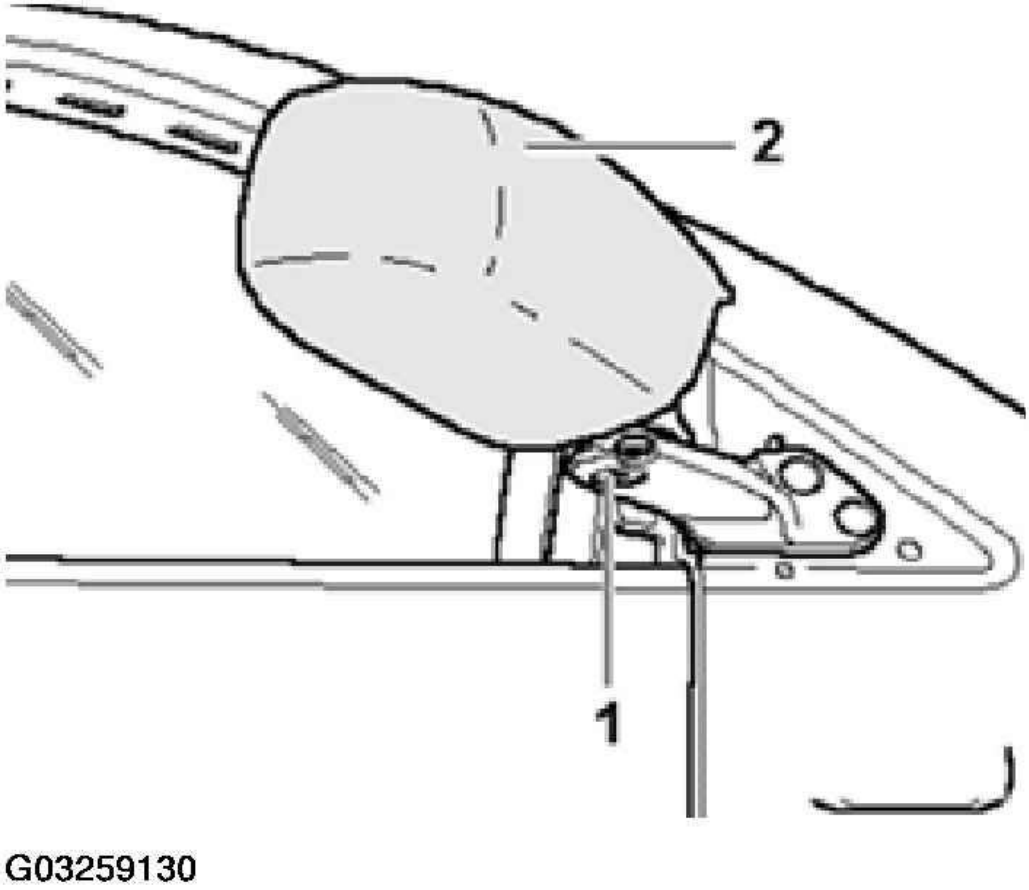


Fig. 122: Scan Tool Display - Mass Air Flow Sensor (5 Of 7)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

If specification not obtained:

- Repeat test and accelerate vehicle under Wide Open Throttle.
- Specification in Display zone 1: above 800 mg/H

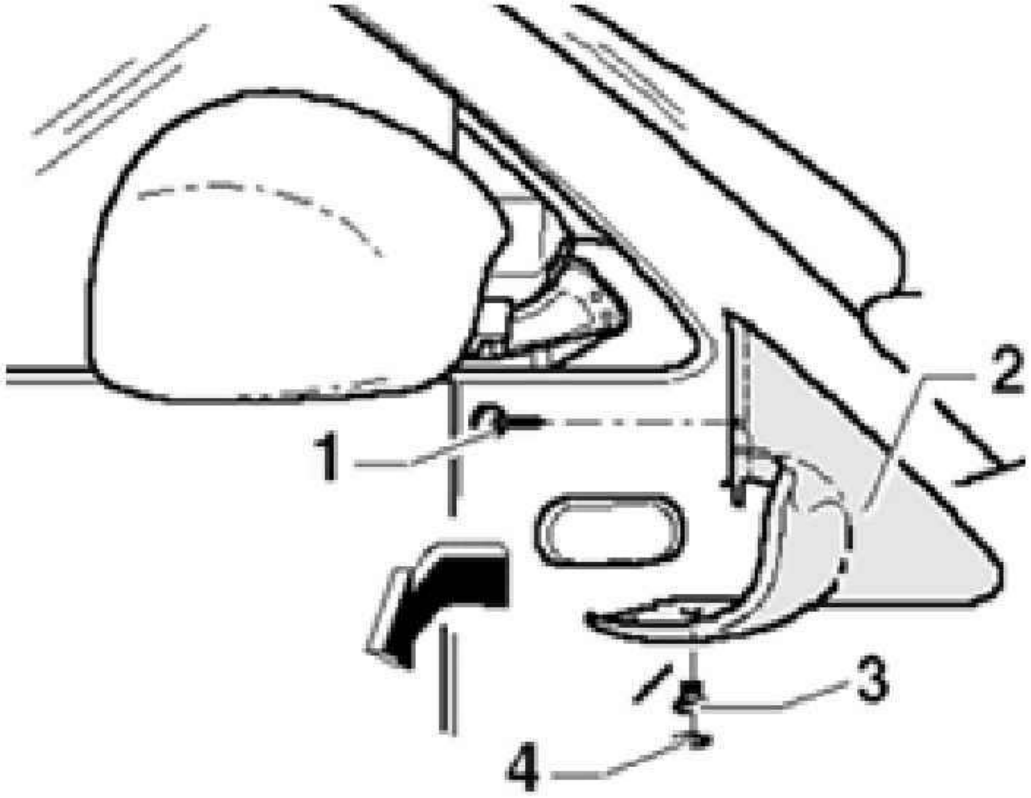


Fig. 123: Scan Tool Display - Mass Air Flow Sensor (6 Of 7)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

If specification not obtained:

- Replace Mass Air Flow Sensor -G70-.
- Display the Readiness code. See **READINESS CODE, DISPLAYING** .

If DTC memory was erased:

- Set the readiness code. See **READINESS CODE, SETTING** .

If 550 mg/H is constantly displayed in zone 1.

- Press --> button.

Display will appear as shown:

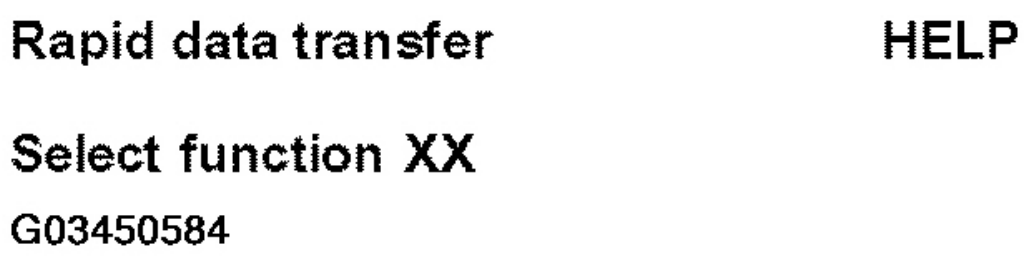


Fig. 124: Scan Tool Display - Mass Air Flow Sensor (7 Of 7)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -6- buttons to select Function 06: "End output".
- Press -Q- button to enter input.
- Switch OFF ignition.
- Disconnect -G70- harness connector. See **DIESEL INJECTION SYSTEM, COMPONENT LOCATIONS OVERVIEW** .
- Switch ON ignition.
- Switch multimeter to 20 Volt range.
- Measure -G70- voltage supply between the following connector terminals:

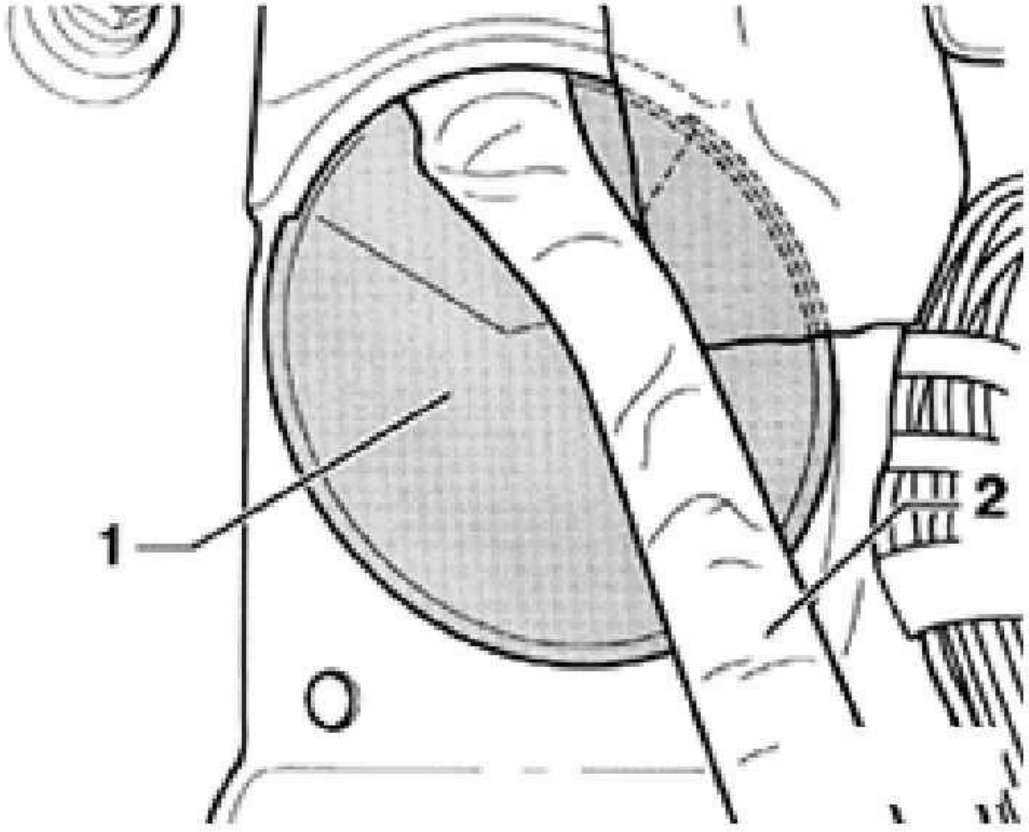


Fig. 125: Identifying MAF Sensor -G70- Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

MAF SENSOR TERMINAL SPECIFICATION CHART

Terminal: -G70-	Specification
2 + Ground	App. battery Voltage
2 + 3	App. battery Voltage
4 + Ground	Approx. 5 Volts
4 + 3	Approx. 5 Volts

If specifications not obtained:

- Switch OFF ignition.
- Connect VAG1598/22 (or 1598/31) Test Box to ECM wiring harness.

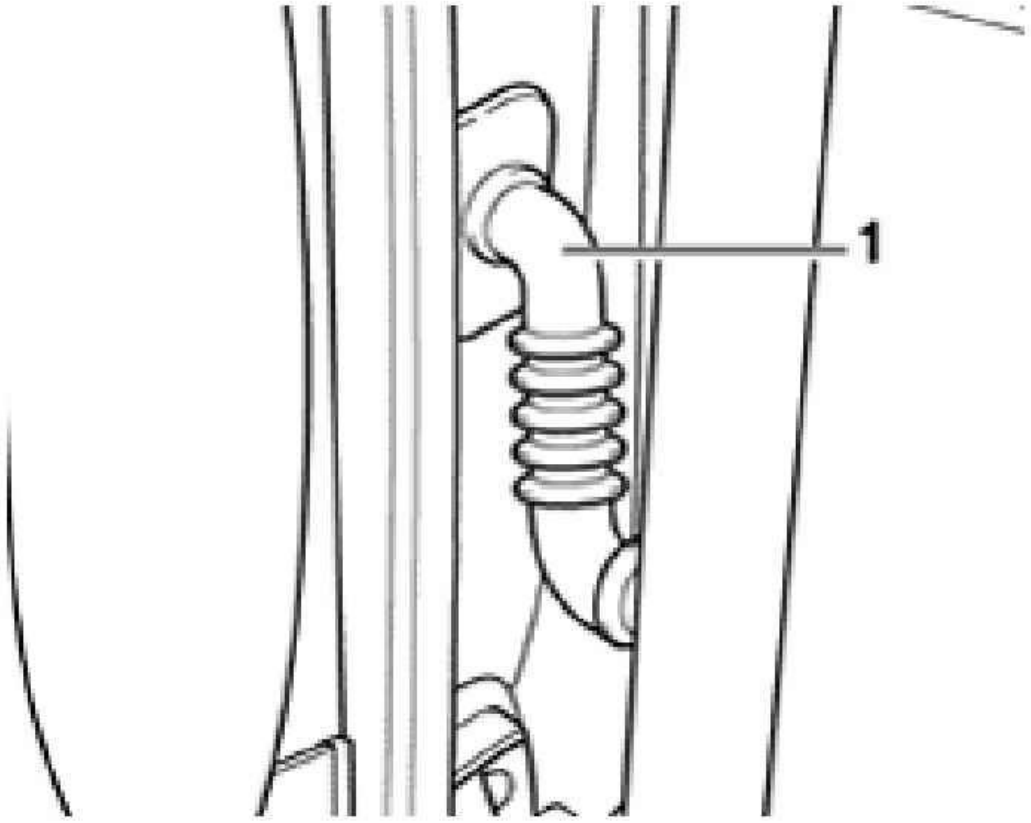


Fig. 126: Connecting VAG1598/22 (Or 1598/31) Test Box To ECM Wiring Harness
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check wiring for open circuit between Test Box and connections using Wiring diagram.

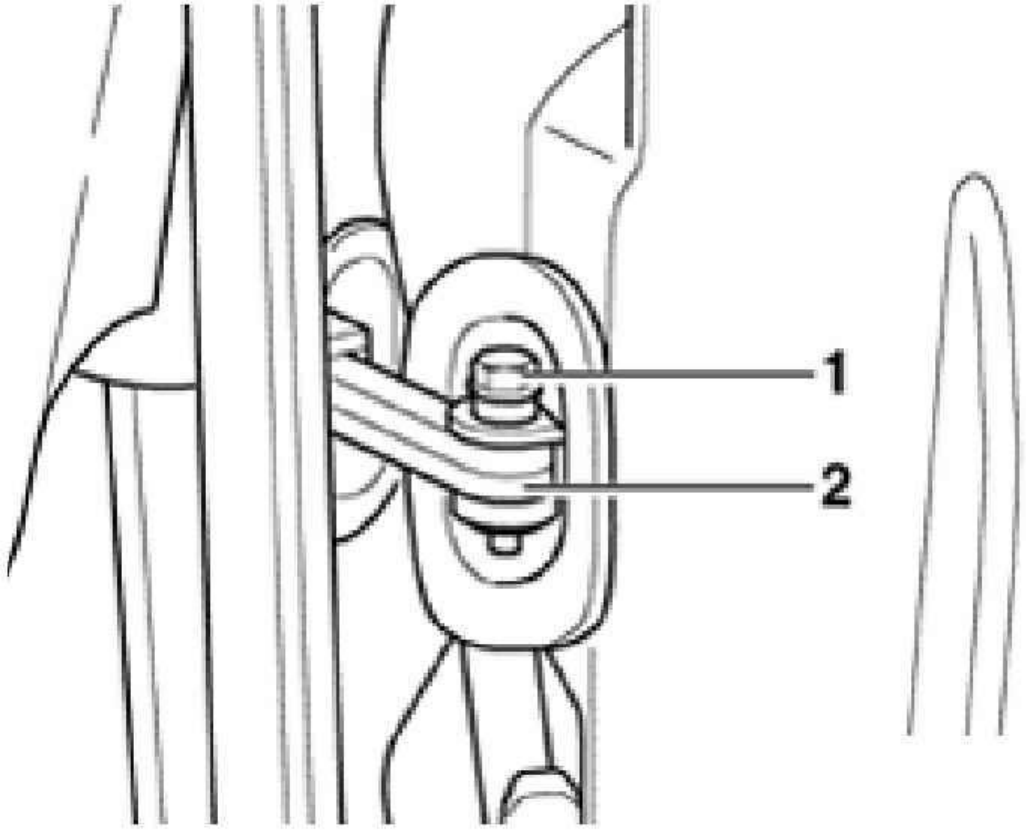


Fig. 127: Identifying MAF Sensor -G70- Harness Connector Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Up to MY 1999

- Terminal 2 + socket 2 and 28
- Terminal 3 + socket 4
- Terminal 4 + socket 50
- Terminal 5 + socket 52

From MY 2000

- Terminal 2 + socket 1 and 2
- Terminal 3 + socket 49

- Terminal 4 + socket 30
- Terminal 5 + socket 68

- Wire resistance: 1.5 ohm maximum

- Check wires for short to one another, to Ground and to Battery +

- Specification: INFINITY ohm

If wiring OK:

- Replace Engine Control Module -J248-. See **Engine Control Module (ECM), replacing** .
- Display the Readiness code. See **READINESS CODE, DISPLAYING** .

If DTC memory was erased:

- Set the readiness code. See **READINESS CODE, SETTING** .

Change-over valve for intake manifold flap -N239-, checking

Special tools

- VAG1390 Hand vacuum pump

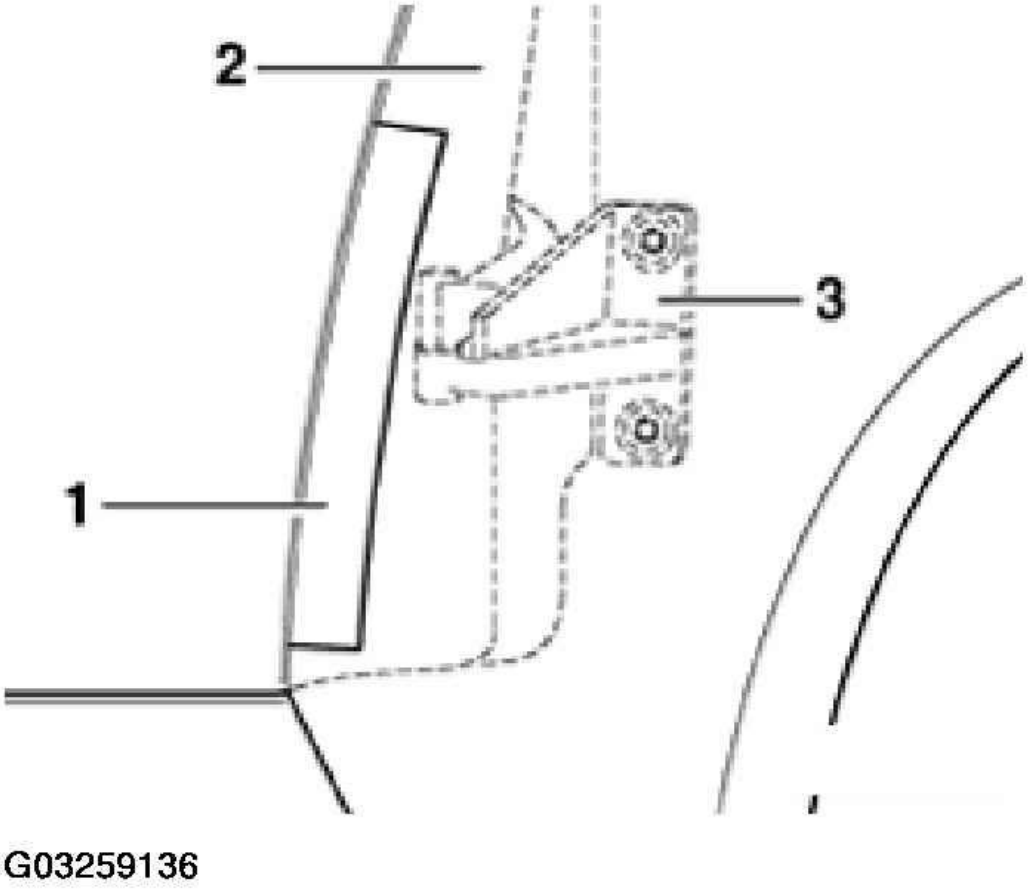


Fig. 128: Identifying Special Tool VAG 1390 Hand Vacuum Pump
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- VAG1598/22 Test Box (MY 1999)
- VAG1598/31 Test Box (from MY 2000)
- Fluke 83 multimeter
- VW 1594 Adapter kit
- Wiring diagram

Function, checking

- Start engine and let idle.
- Switch OFF ignition.
- Observe position of lever on intake manifold change-over flap (using 2nd technician)

- Intake manifold change-over flap must (after switching OFF ignition) close back and after approx. 3 seconds re-open.

If change-over does not occur, perform following checks:

- Check intake manifold change-over flap mechanics for freedom of movement by manually operating the rods by hand.
- Check vacuum function of positioning actuator using VAG1390 hand vacuum pump.
- Check vacuum lines for correct connection.

If mechanical components OK:

- Check Intake Manifold Change-over Valve - N239-.

Test sequence

- Disconnect -N239- harness connector.
- Measure resistance between -N239- terminals.

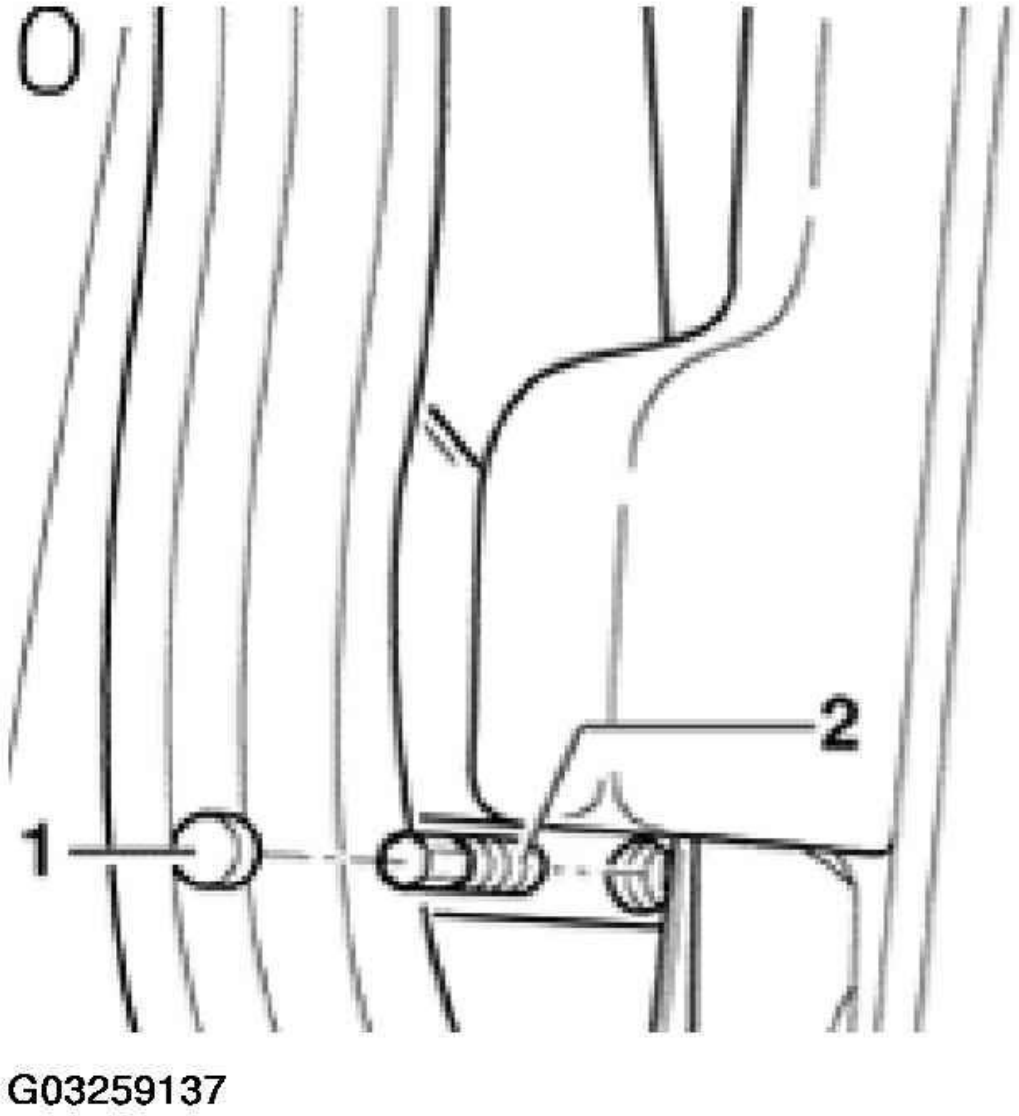


Fig. 129: Measuring Resistance Between Change-Over Valve For Intake Manifold Flap -N239- Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Specification: 25 to 45 ohm

If specification not obtained:

- Replace Intake Manifold Change-over Valve -N239-.

If specification obtained:

- Switch Fluke 83 multimeter to 20 Volt range.
- Connect multimeter between terminals 1 and 2 of ECM connector using jumper wires from VW 1594 Adapter kit.

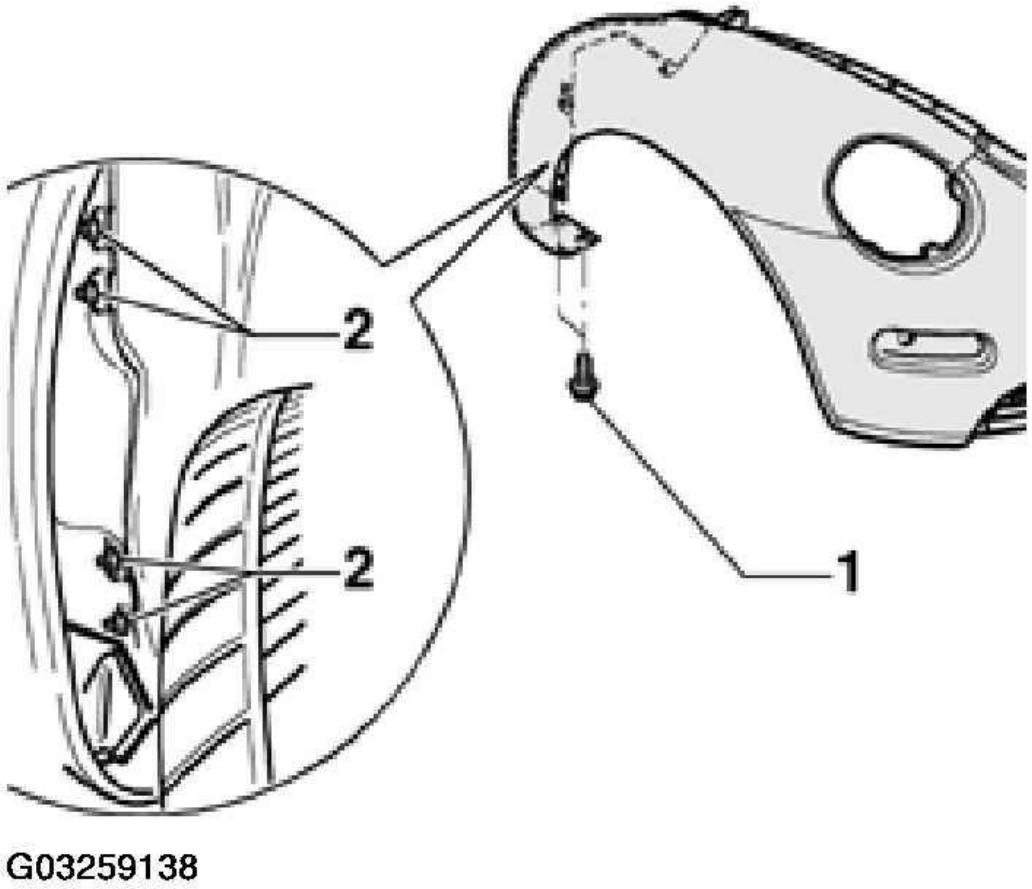


Fig. 130: Identifying Change-Over Valve For Intake Manifold Flap -N239- Harness Connector Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Start engine and let idle.
- Specification: between 5 and 6 Volts
- Switch OFF ignition.

- Voltage value must rise to 11 to 15 Volts (battery Voltage) and after approx. 3 seconds fall to 0 Volts.

If Voltage values do not change as described:

- Connect VAG1598/22 (or 1598/31) Test Box to ECM wiring harness.

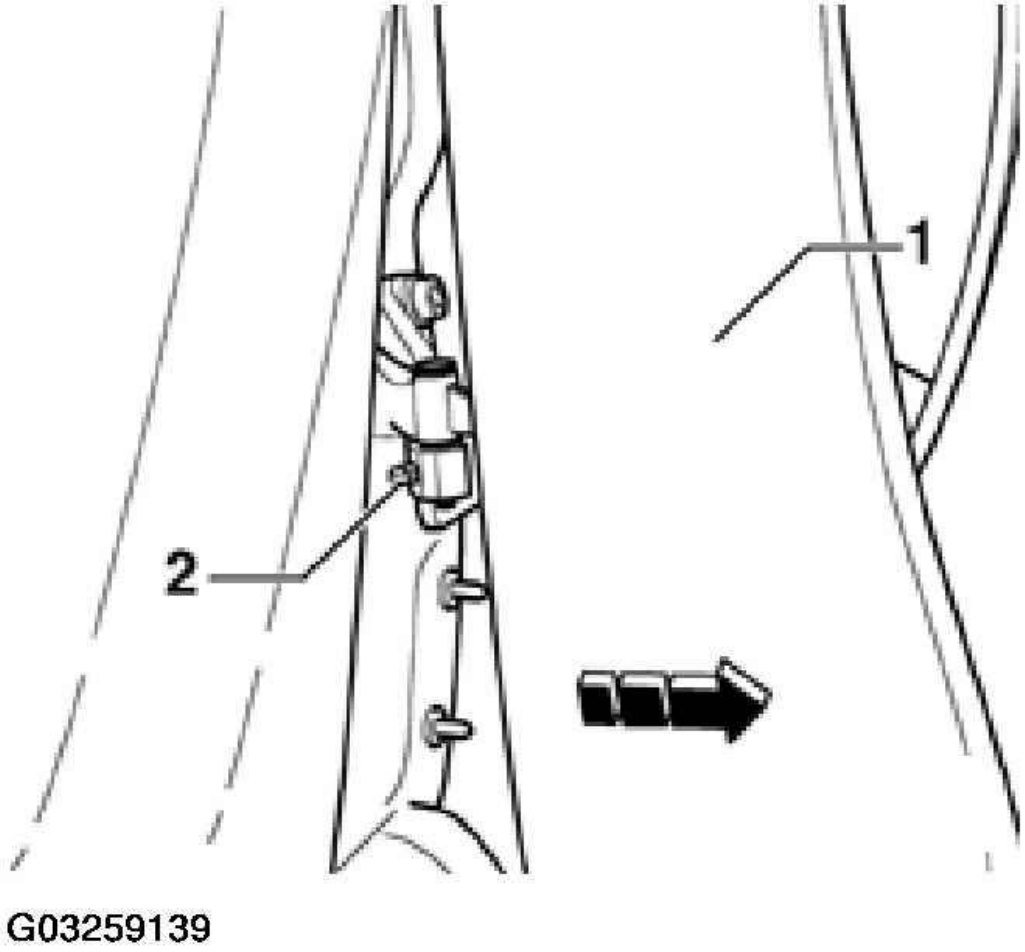


Fig. 131: Connecting VAG1598/22 (Or 1598/31) Test Box To ECM Wiring Harness
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check wiring for open circuit between Test Box and connector using Wiring diagram.

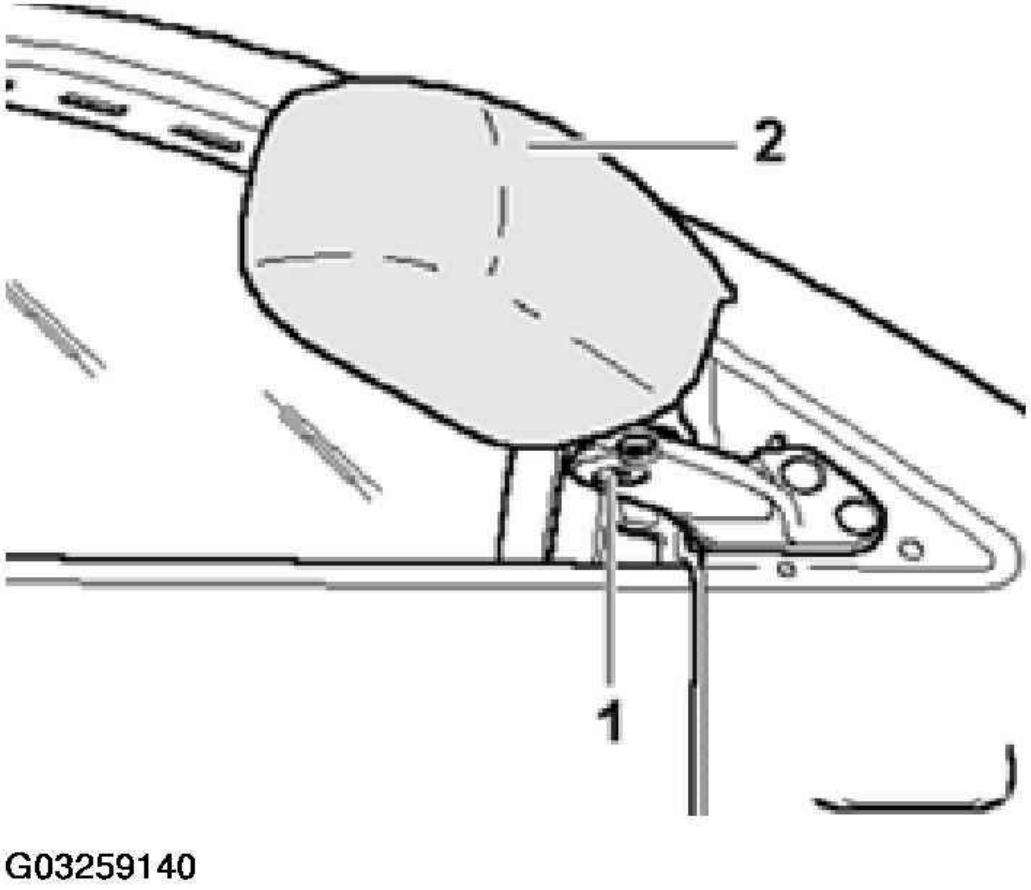


Fig. 132: Identifying Change-Over Valve For Intake Manifold Flap -N239- Harness Connector Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Up to MY 1999

- Terminal 1 + socket 3
- Terminal 2 + sockets 2 and 28

From MY 2000

- Terminal 1 + socket 81
- Terminal 2 + sockets 1 and 2

- Wire resistance: 1.5 ohm maximum

- Check wires for shorting to: one another, Ground and Battery +.
- Specification: INFINITY ohm

If wiring OK:

- Replace Engine Control Module -J248-. See **Engine Control Module (ECM), replacing** .

DIESEL DIRECT FUEL INJECTION (DFI) ENGINE CONTROL MODULE (ECM) -J248-, REPLACING AND CODING

Engine Control Module (ECM), replacing

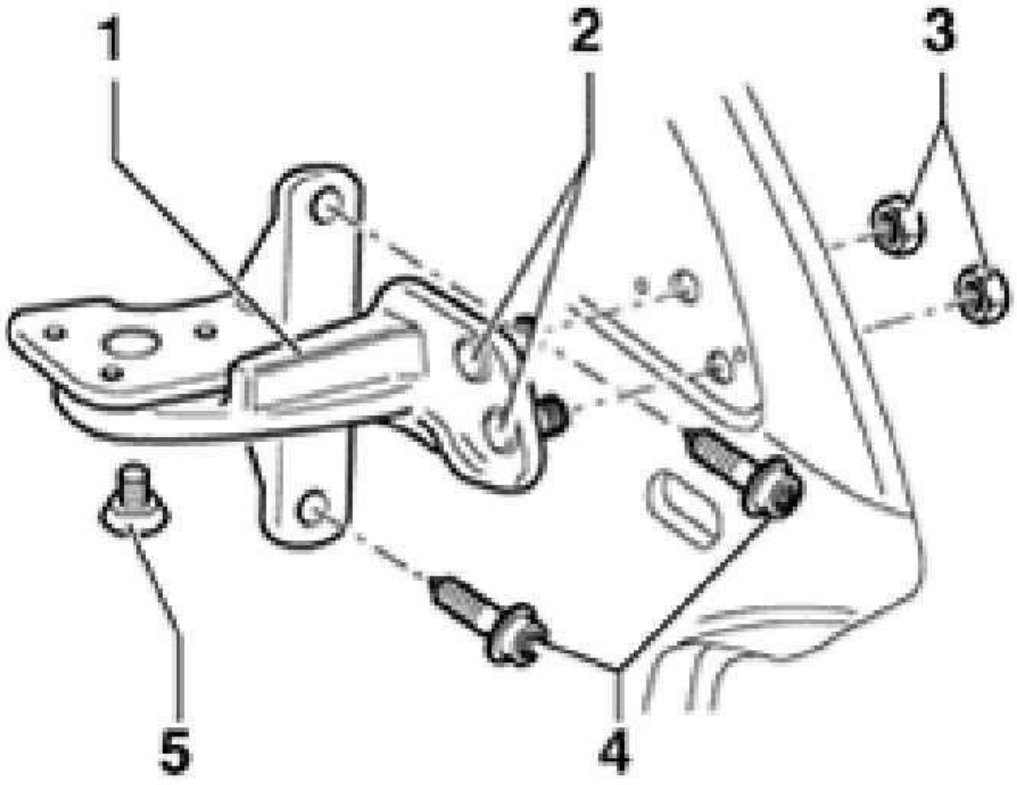
Special tools

- VAG1551/1552 Scan Tool using VAG1551/3 Adapter cable

Work sequence

- Print out the ECM identification (and thereby the previous ECM coding) as follows:
- Connect VAG1551/1552 Scan Tool. See **VAG1551/1552 SCAN TOOL, CONNECTING** .
- Press -0- and -1- buttons to select Address word 01: "Engine electronics"

Display will appear as shown (I.D. example only):



1 - Door hinge.

2 - Threaded stud.

3 - Nut (20 Nm + 90°).

4 - Bolt (20 Nm + 90°).

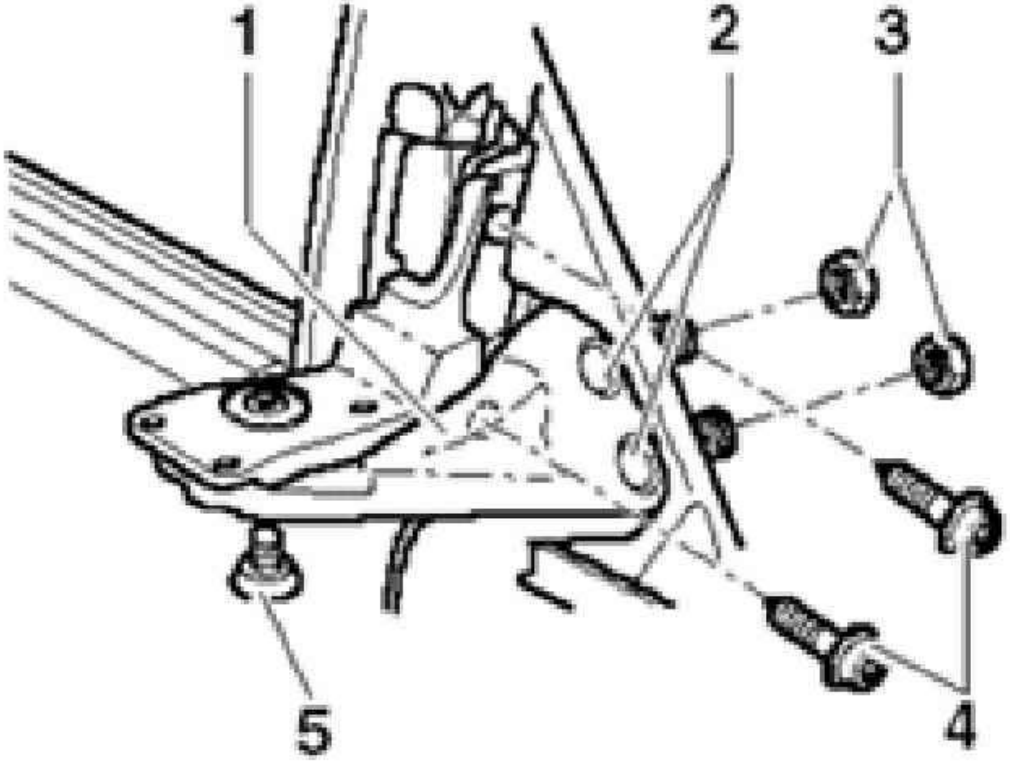
5 - Bolt (27 Nm).

G03259141

Fig. 133: Scan Tool Display - Replacing Engine Control Module (1 Of 3)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press Scan Tool print button to print out ECM identification.
- Press --> button.

Display will appear as shown:



1 - Door hinge.

2 - Threaded stud.

3 - Nut (20 Nm + 90°).

4 - Bolt (20 Nm + 90°).

5 - Bolt (27 Nm).

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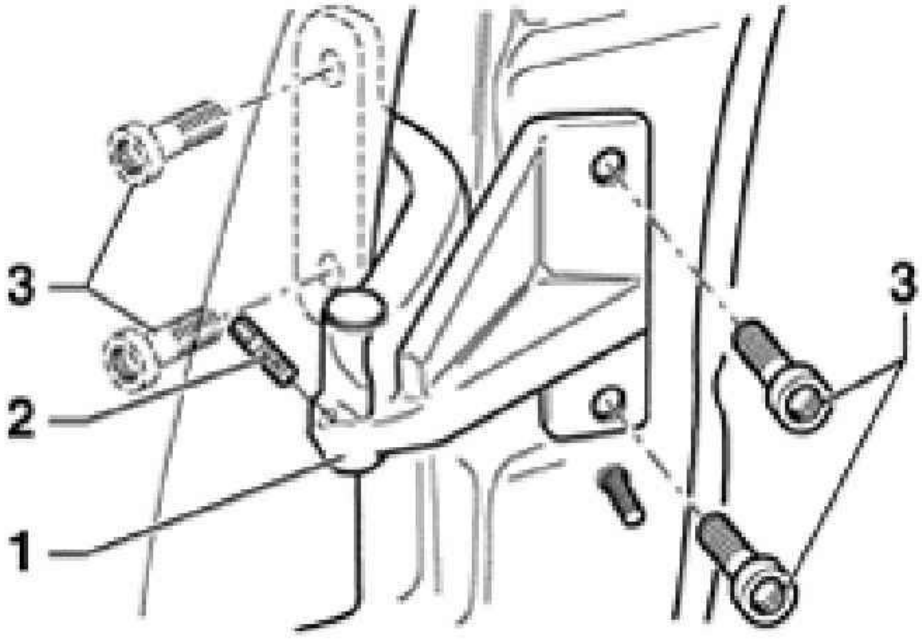
Fig. 134: Scan Tool Display - Replacing Engine Control Module (2 Of 3)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -6- buttons to select Function 06: "End output"
- Press -Q- button to enter input.

Display will appear as shown:



1 - Door hinge.

2 - Grub screw (13 Nm).

3 - Bolt (20 Nm + 90 °).

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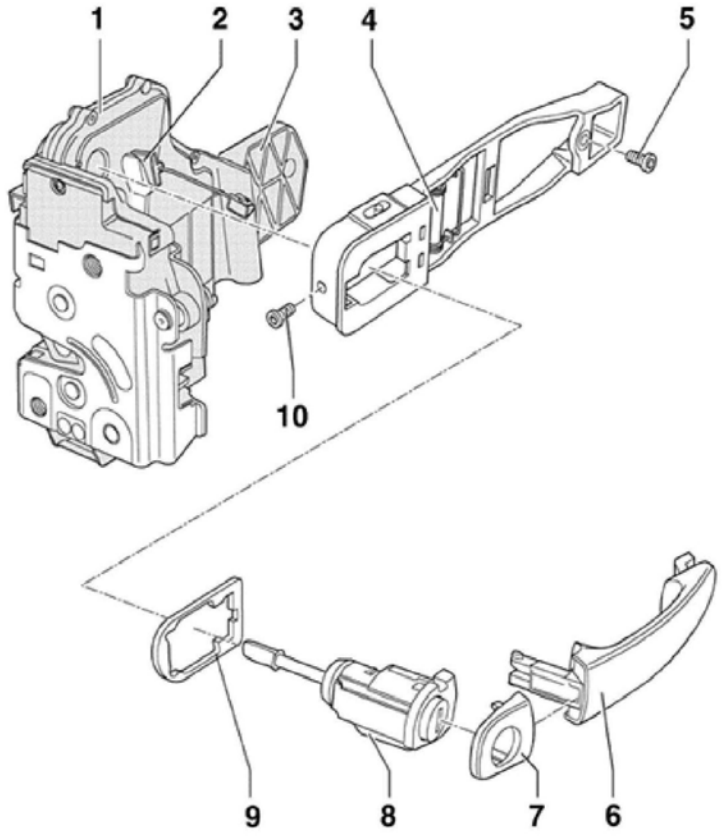
Fig. 135: Scan Tool Display - Replacing Engine Control Module (3 Of 3)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Switch OFF ignition.
- Remove inner covers on plenum.

See **INTERIOR TRIM** .

- Carefully pry off retainer bar with screwdriver (arrow).



1 - Door lock
2 - Cable
3 - Retaining bracket
4 - Bearing bracket
5 - Multi-point socket head bolt
6 - Door handle
7 - Cover cap
8 - Lock cylinder housing
9 - Backing piece
10 - Multi-point socket head bolt

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Fig. 136: Prying Off ECM Retainer Bar With Screwdriver
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Release harness connector from Engine Control Module (ECM) and pull off.

- Insert new ECM and press to the left.
- Tighten nut for ground wire (located in front of ECM) to 9 +/- 1 Nm (80 +/- 9 in. lb)
- Check previous ECM coding and coding of new ECM. See **ENGINE CONTROL MODULE (ECM), CODING** .
- Activate Cruise Control System. See **CRUISE CONTROL SYSTEM, ACTIVATING AND DEACTIVATING** .
- Check DTC memory of new ECM, erase if necessary. See **DTC MEMORY, CHECKING** .
- Adapt new control module to immobilizer. See **ANTI-THEFT IMMOBILIZER, ON BOARD DIAGNOSTIC (OBD)** .

Engine Control Module (ECM), coding

If appropriate code for vehicle is not displayed or if ECM has been replaced, code ECM as follows.

Special tools

- VAG1551/1552 Scan Tool using VAG1551/3 Adapter cable

Work sequence

- Connect VAG1551/1552 Scan Tool. See **VAG1551/1552 SCAN TOOL, CONNECTING** .
- Switch ON ignition but do not start engine.
- Press -0- and -1- buttons to select Address word 01: "Engine electronics"

Display will appear as shown (I.D. example only):

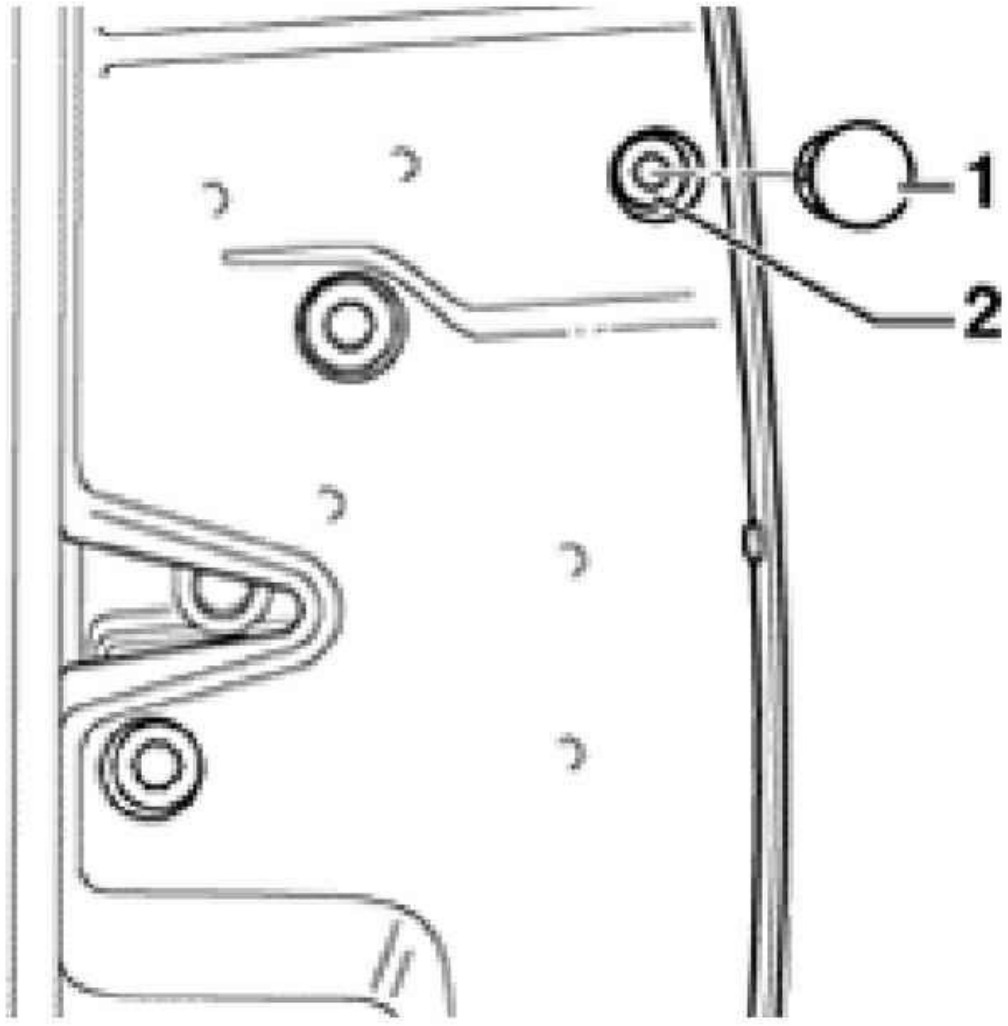

Fig. 137: Scan Tool Display - Coding Engine Control Module (1 Of 3)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press --> button.

Display will appear as shown:

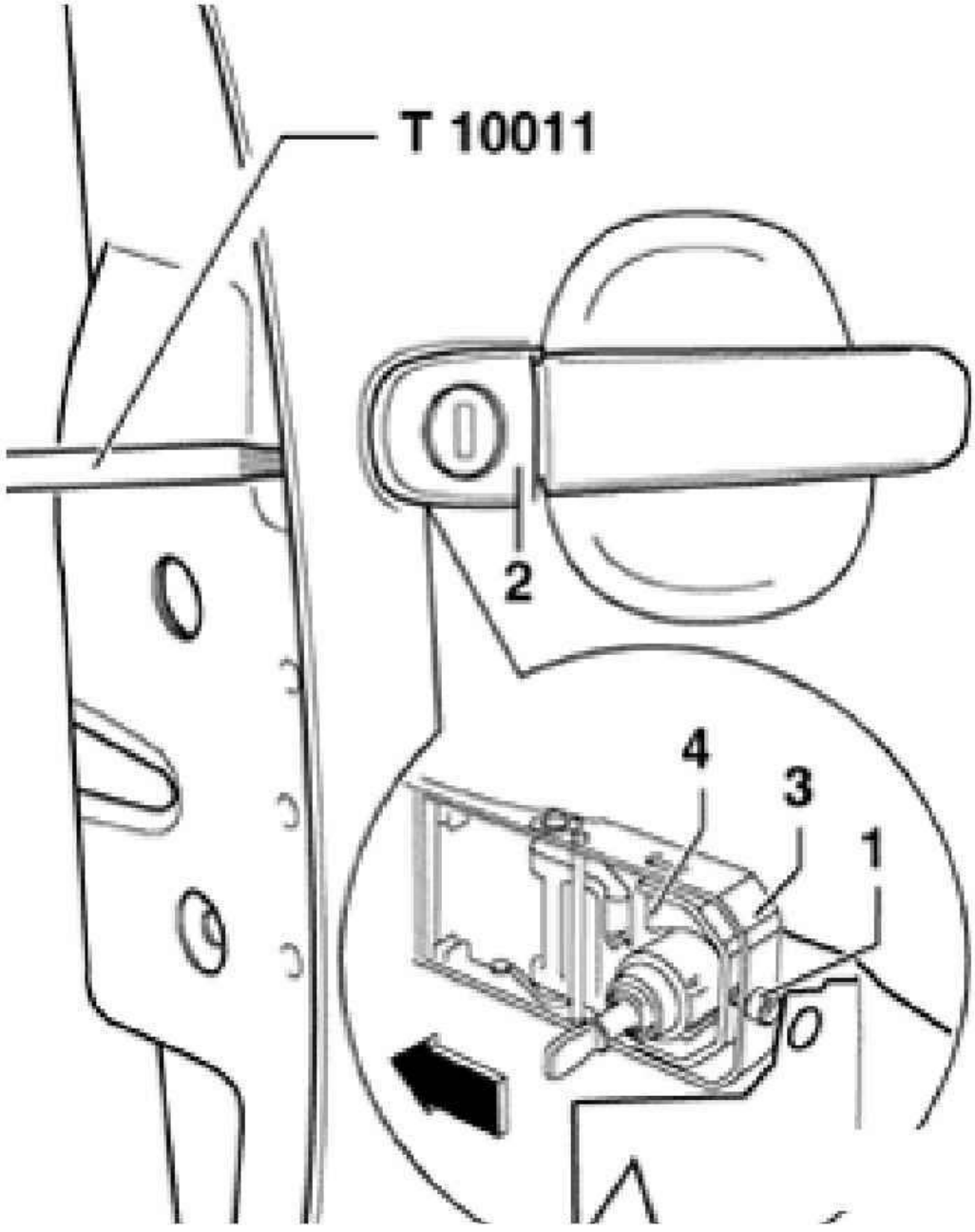

Fig. 138: Scan Tool Display - Coding Engine Control Module (2 Of 3)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -7- buttons to select Function 07: "Code control module".
- Press -Q- button to enter input.

Display will appear as shown:

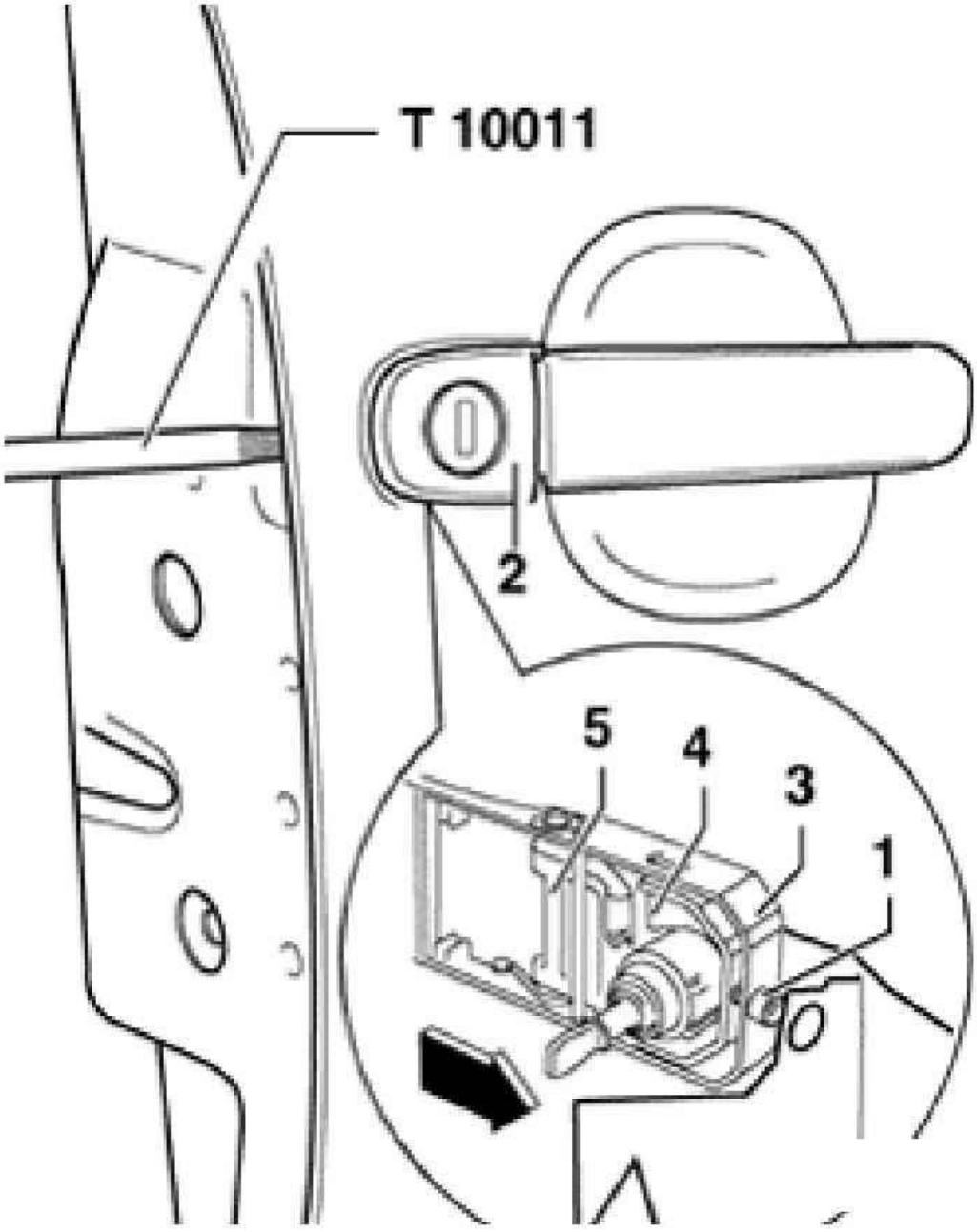

Fig. 139: Scan Tool Display - Coding Engine Control Module (3 Of 3)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Enter appropriate code number for this vehicle. Coding tables. See **Engine control module coding, m.y. 1998-1999** and **Engine control module coding, from m.y. 2000** .

Engine control module coding, m.y. 1998-1999

TRANSMISSION CODING M.Y. 1998-1999 (EXCEPT ECM VERSION: 038 906 018 BD)

Transmission	ABS	Coding
Automatic	Yes	00001
Manual	Yes	00002
Automatic	No	00004

NOTE: The following code is valid for ECM version: 038 906 018 BD.

TRANSMISSION CODING M.Y. 1998-1999 (ONLY FOR ECM VERSION: 038 906 018 BD)

Transmission	ABS	Coding
Manual	No	00002

Engine control module coding, from m.y. 2000

Transmission Coding From M.Y. 2000

Transmission	ABS	Coding
Automatic	Yes	00001
Manual	Yes	00002
Manual	No	00002
Automatic	No	00004

- Press -Q- button to enter input.

Display will appear as shown (I.D. example only):

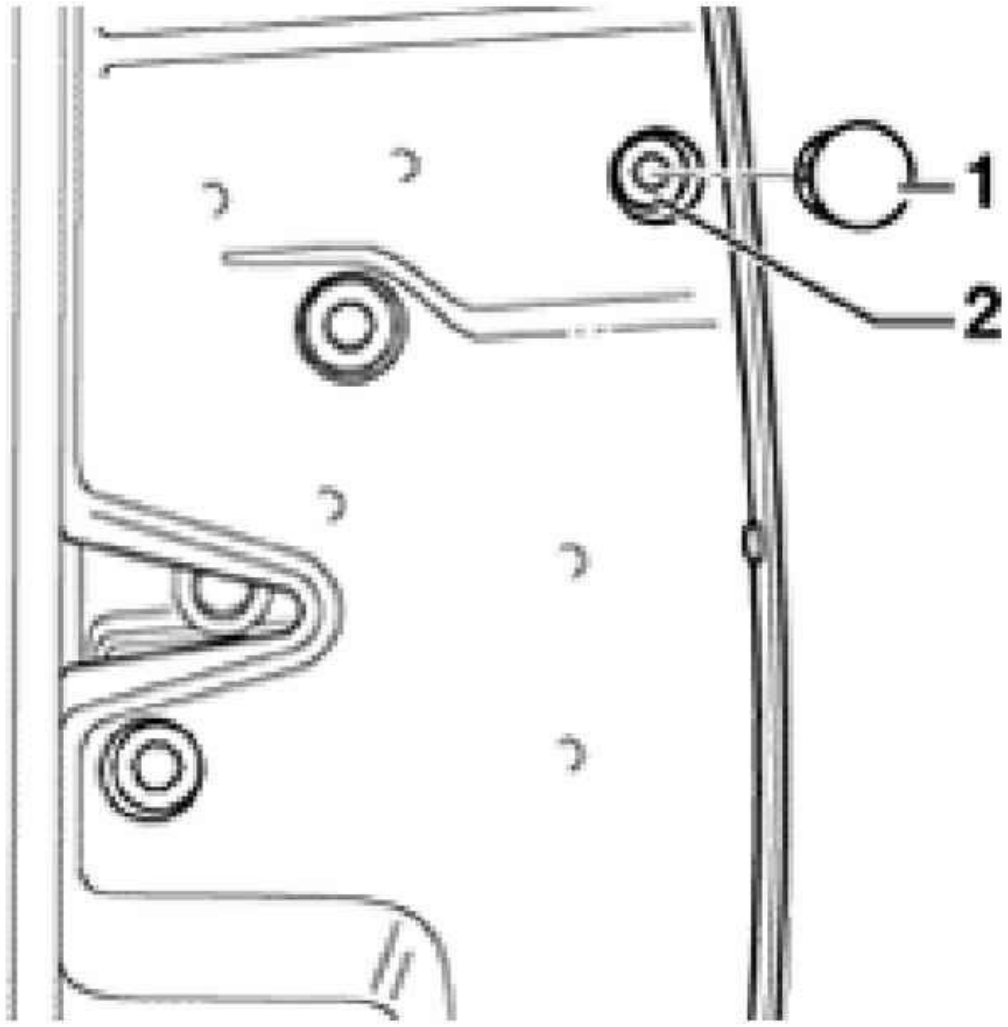

Fig. 140: Scan Tool Display - Coding ECM From M.Y. 2000
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Switch ignition OFF and then ON again.

NOTE: Entered coding is activated by switching ignition OFF and then ON again. If, after entering correct code, ignition is NOT switched OFF and ON again, malfunction: "Control Module incorrectly coded" will become stored in DTC memory and must be erased.

- Erase DTC memory. See **DTC MEMORY, CHECKING** .
- Set readiness code. See **READINESS CODE, SETTING** .

CRUISE CONTROL SYSTEM, CHECKING, ACTIVATING AND DEACTIVATING

Cruise control system, checking

Cruise Control System, apart from control switches, has no components of its own. All functions are provided by the Fuel injection system.

Special tools

- VAG1551/1552 Scan Tool using VAG1551/3 Adapter cable
- VAG1598/22 Test Box (MY 1999)
- VAG1598/31 Test Box (from MY 2000)
- Fluke 83 multimeter
- VW 1594 Adapter kit
- Wiring diagram

Test sequence

- Connect VAG1551/1552 Scan Tool. See **VAG1551/1552 SCAN TOOL, CONNECTING** .
- Start engine and let idle.
- Press -0- and -1- buttons to select Address word 01: "Engine electronics"

Display will appear as shown (example only):

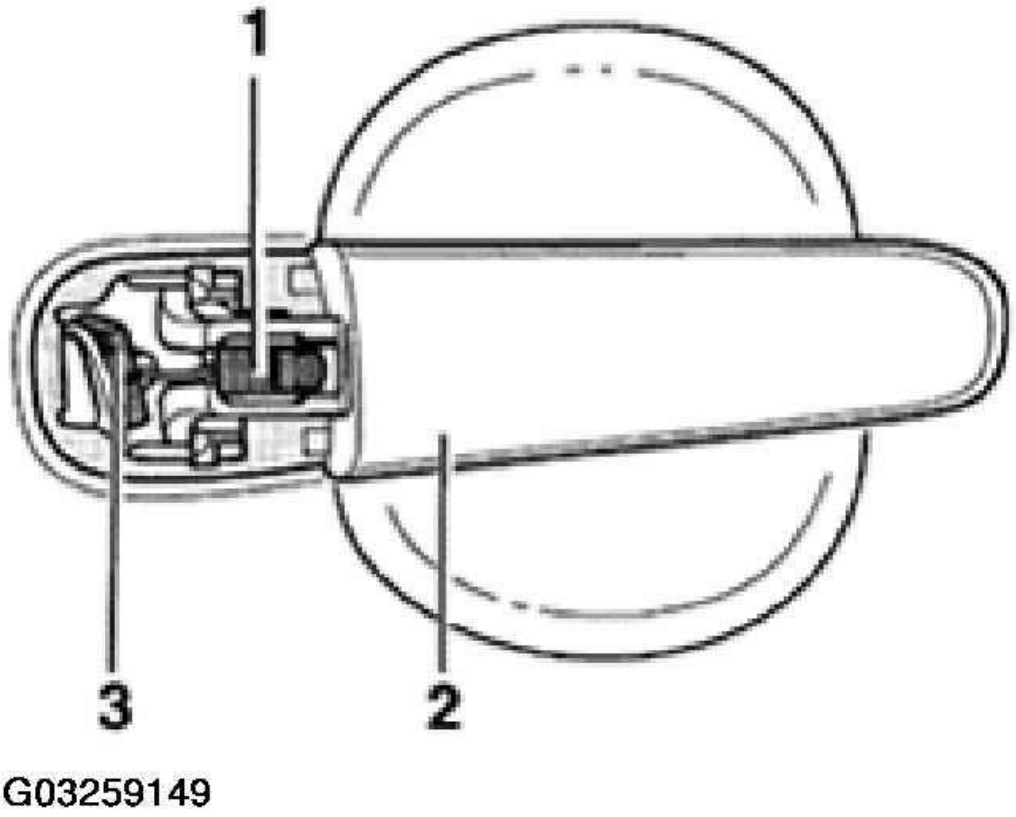

Fig. 141: Scan Tool Display - Checking Cruise Control System (1 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press --> button.

Display will appear as shown:

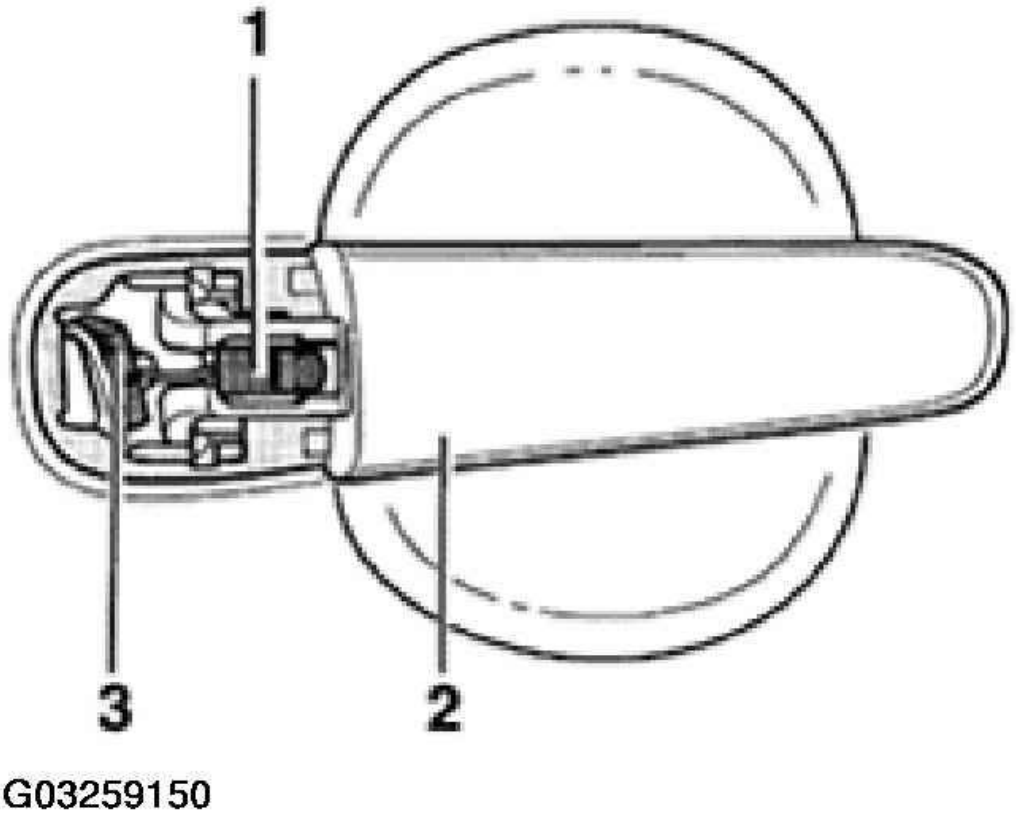

Fig. 142: Scan Tool Display - Checking Cruise Control System (2 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -8- buttons to select Function 08: "Read measuring value block".
- Press -Q- button to enter input.

Display will appear as shown:

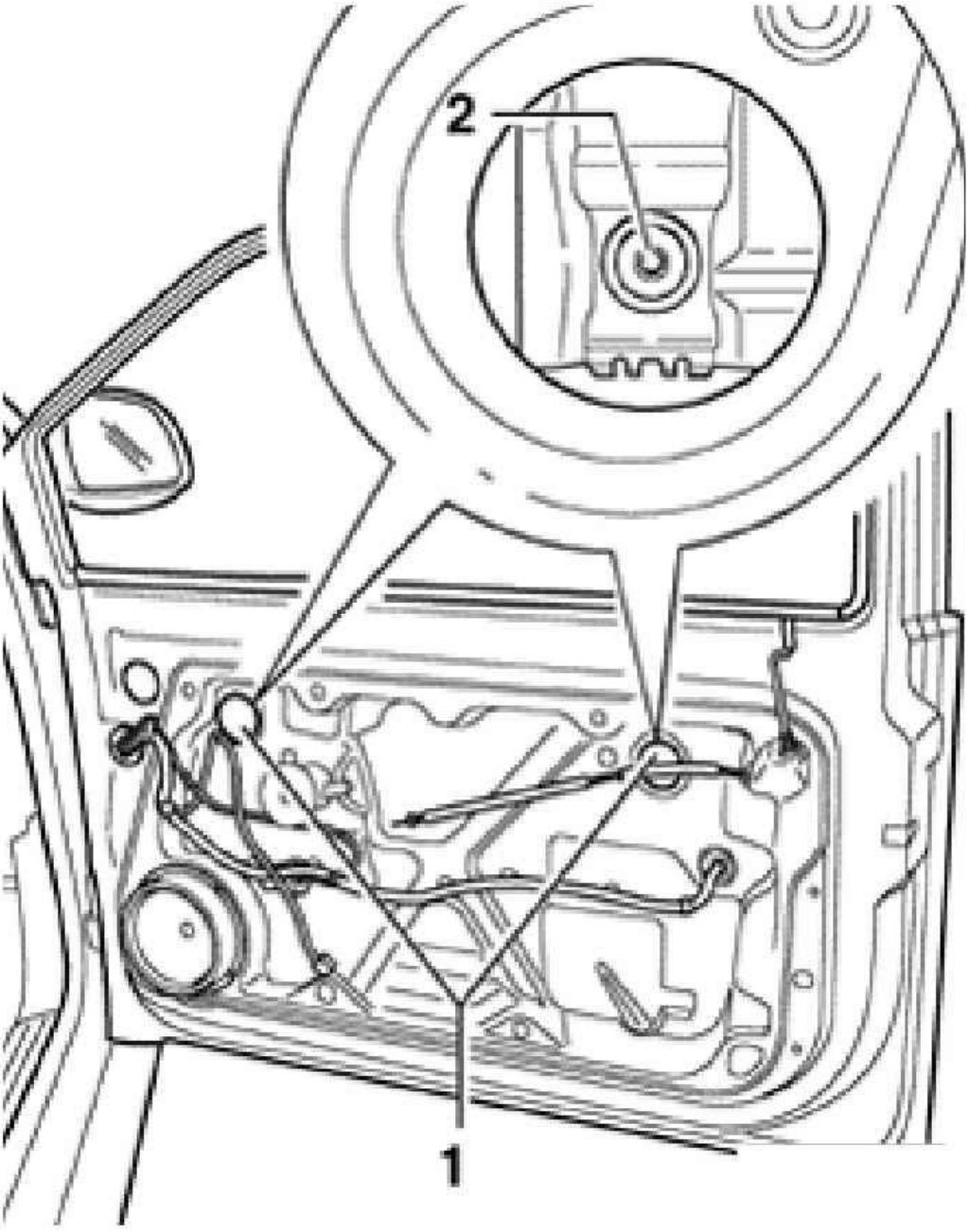

Fig. 143: Scan Tool Display - Checking Cruise Control System (3 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press buttons -0-, -0- and -6- to select "Display group 6".
- Press -Q- button to enter input.
- Observe display in Display zone 4.

Specification: 0

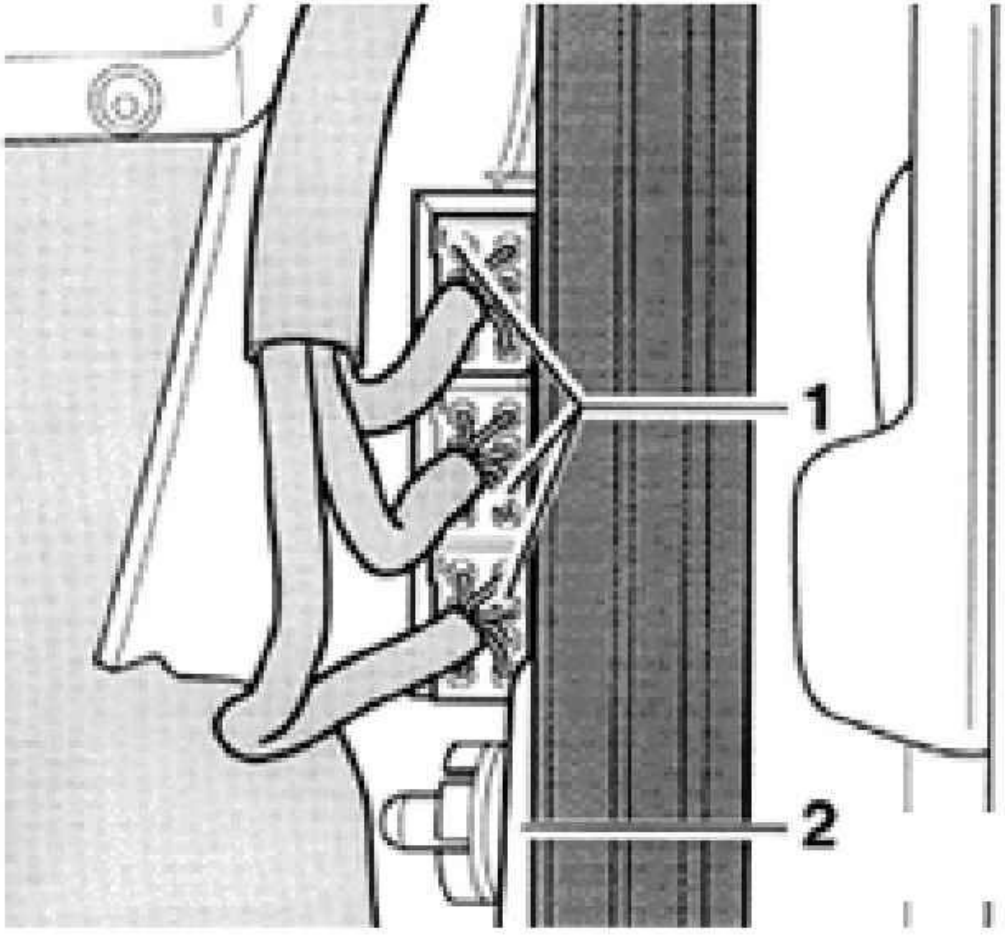

Fig. 144: Scan Tool Display - Checking Cruise Control System (4 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

If 255 is displayed in zone 4:

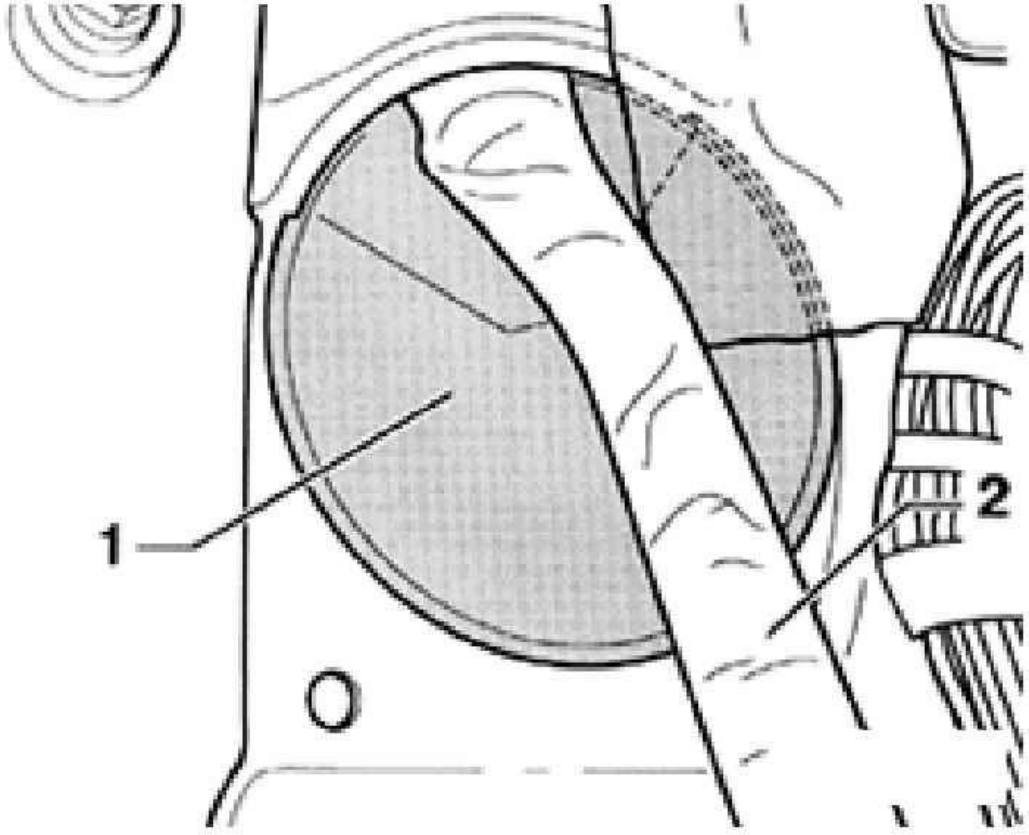

Fig. 145: Scan Tool Display - Checking Cruise Control System (5 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Activate Cruise Control System. See **CRUISE CONTROL SYSTEM, ACTIVATING AND DEACTIVATING** .

Vehicles with automatic transmission only

- Take a test drive where vehicle reaches at least 30 km/h (approx. 19 mph) one time.
- Switch OFF engine and leave selector lever in position 2, 3 or D.
- Apply hand brake.

NOTE:

- **For vehicles with automatic transmissions; cruise control switch Voltage supply first becomes available when the vehicle exceeds a speed of 30 km/h (approx. 19 mph) with the Range selector lever in position 2, 3 or D.**

- **Voltage supply is also available during idle as long as a driving Range other than 1 or R is selected.**

Check specification Display zone 3.

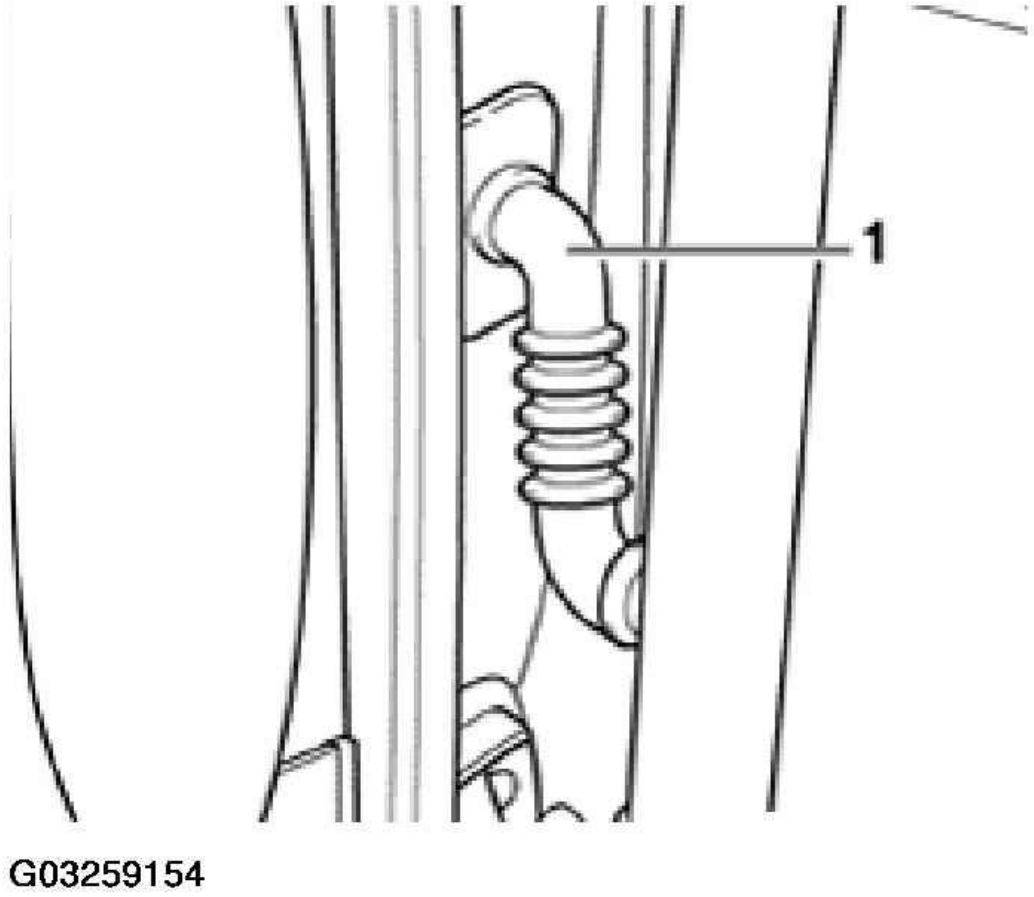

Fig. 146: Scan Tool Display - Checking Cruise Control System (Automatic Transmission) (1 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Checking requirements

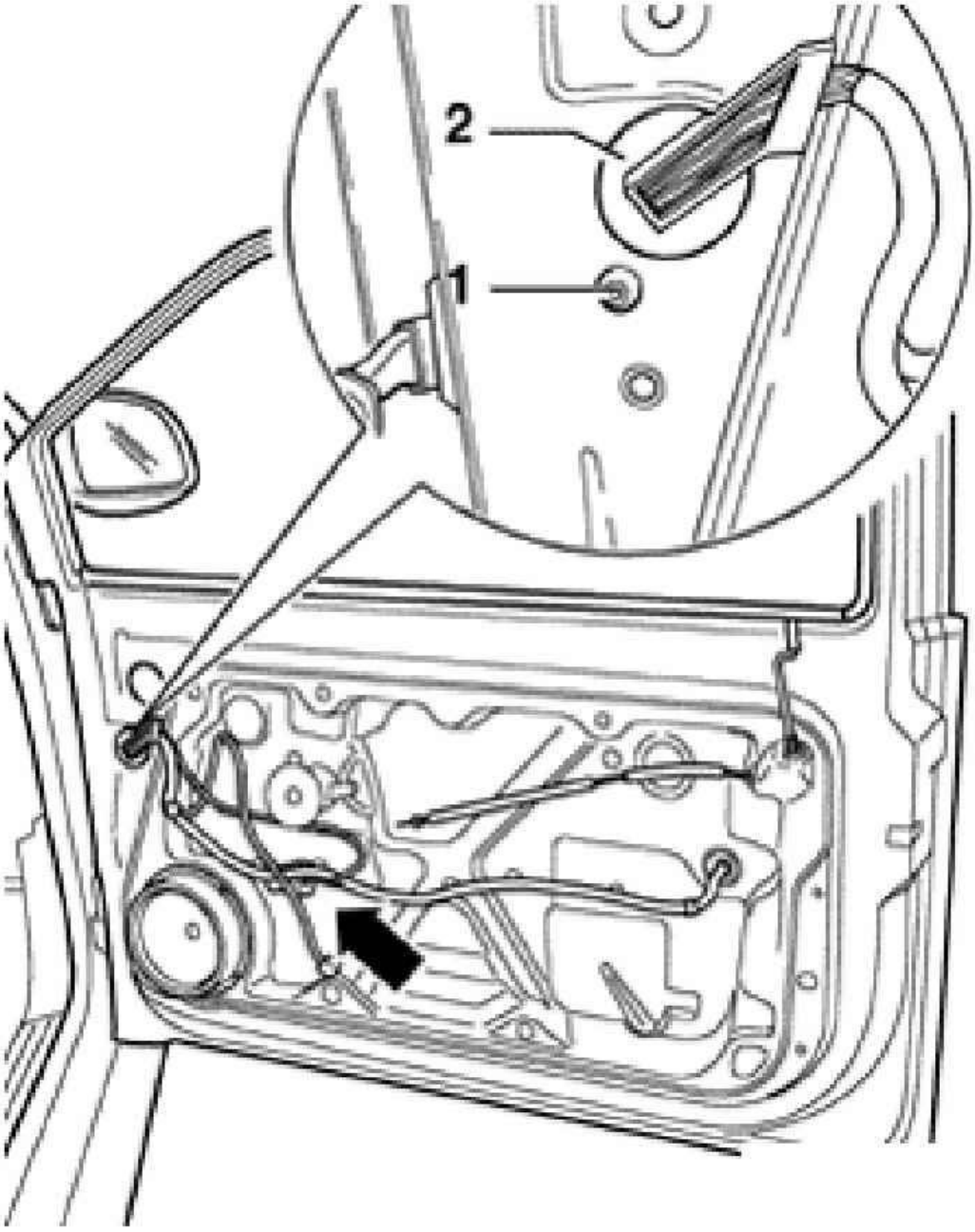

Fig. 147: Identifying Switch A & B
Courtesy of VOLKSWAGEN OF AMERICA, INC.

CRUISE CONTROL SWITCH SPECIFICATIONS

Checking requirements	Display zone 3
Switch B engaged at "OFF"	000000
Switch B at "OFF" before switch point	000001
Switch B at "ON"	000011
Switch B at "RES"	001011
Switch A pressed	000111
Brake pedal depressed	010011
Clutch pedal depressed	100011

If specifications not obtained:

- Press --> button.

Display will appear as shown:

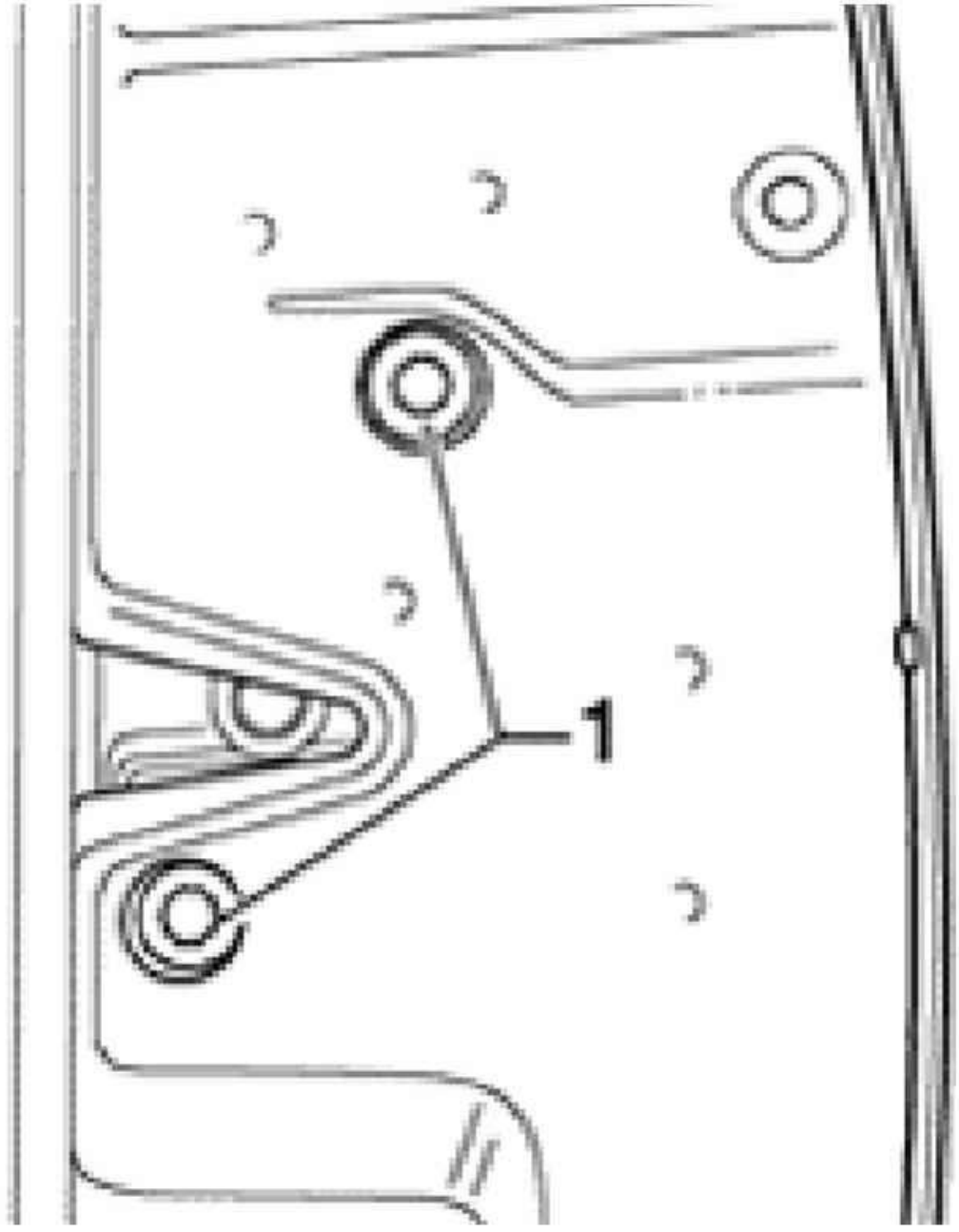

Fig. 148: Scan Tool Display - Checking Cruise Control System (Automatic Transmission) (2 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -6- buttons to select Function 06: "End output".
- Press -Q- button to enter input.
- Switch OFF ignition.
- Connect VAG1598/22 (or 1598/31) Test Box to ECM wiring harness.

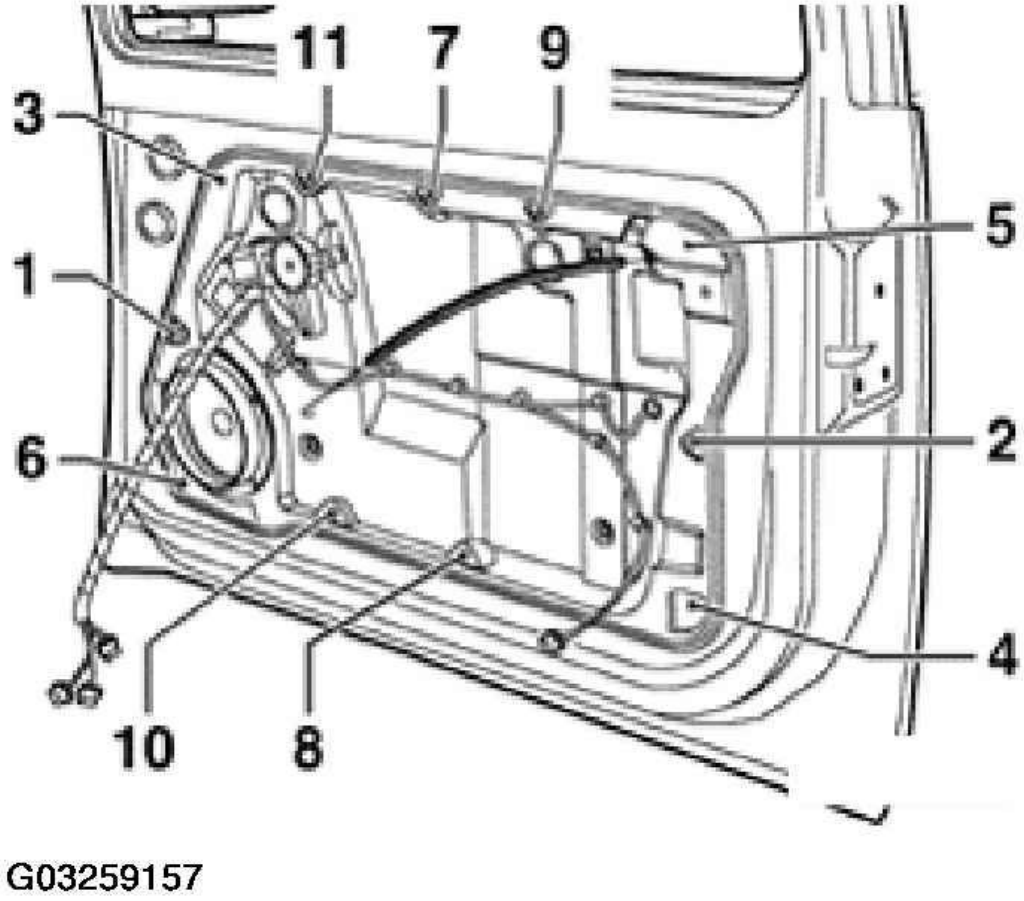

Fig. 149: Connecting VAG 1598/22 Test Box To ECM Wiring Harness
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check wiring for open/short circuits between the Engine Control Module and the Cruise Control System switches using Wiring diagram.

See appropriate System Wiring Diagram article.

Cruise Control System, activating and deactivating

- Connect VAG1551/1552 Scan Tool. See **VAG1551/1552 SCAN TOOL, CONNECTING** .
- Press buttons -0- and -1- to insert "Engine electronics" address word 01.

Indicated on display:

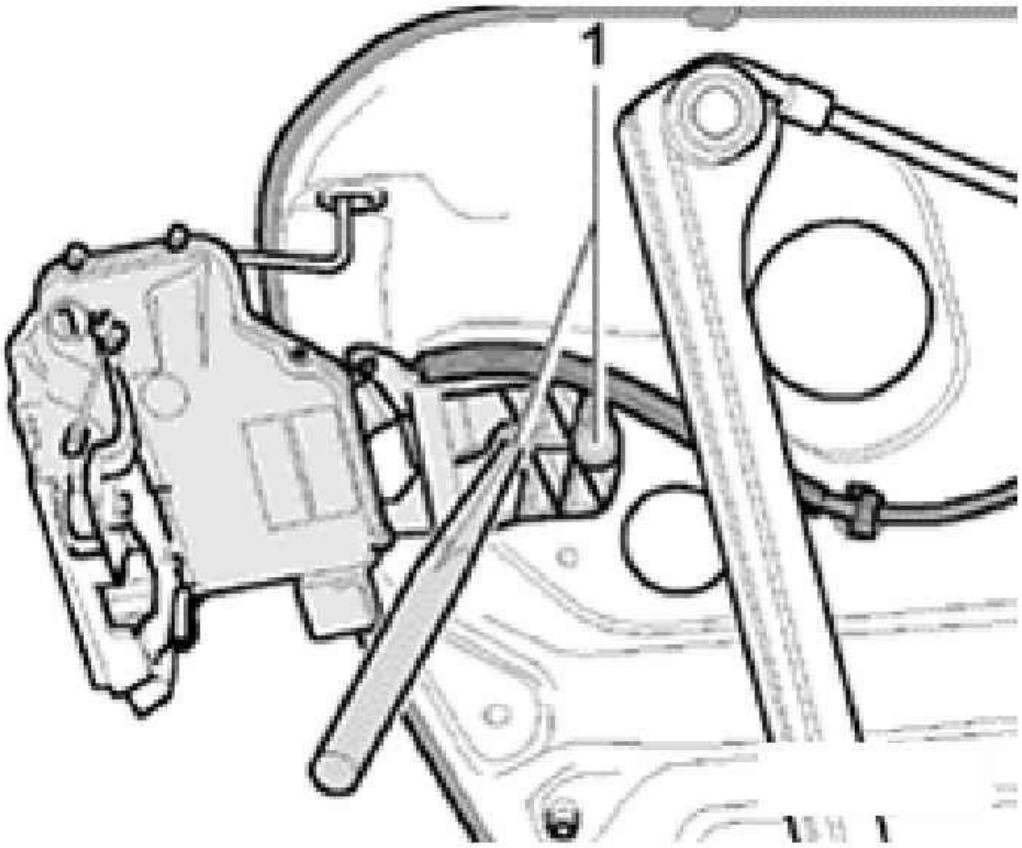

Fig. 150: Scan Tool Display - Activating & Deactivating Cruise Control System (1 Of 3)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press buttons -1- and -1- to select "Login procedure" function 11.
- Press -Q- button to confirm input

Indicated on display:

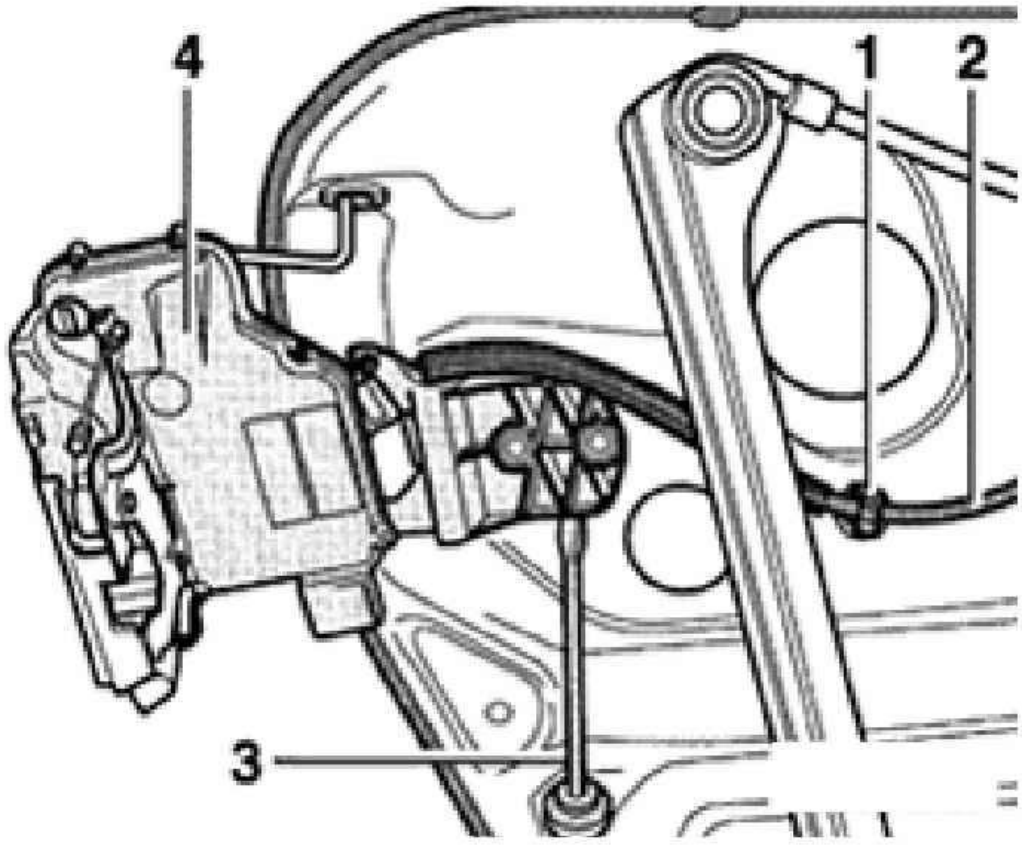

Fig. 151: Scan Tool Display - Activating & Deactivating Cruise Control System (2 Of 3)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Enter relevant code number:

Cruise Control Code Chart

Code	
11463	activate cruise control system
16167	deactivate cruise control system

- Press -Q- button to confirm input

Indicated on display:

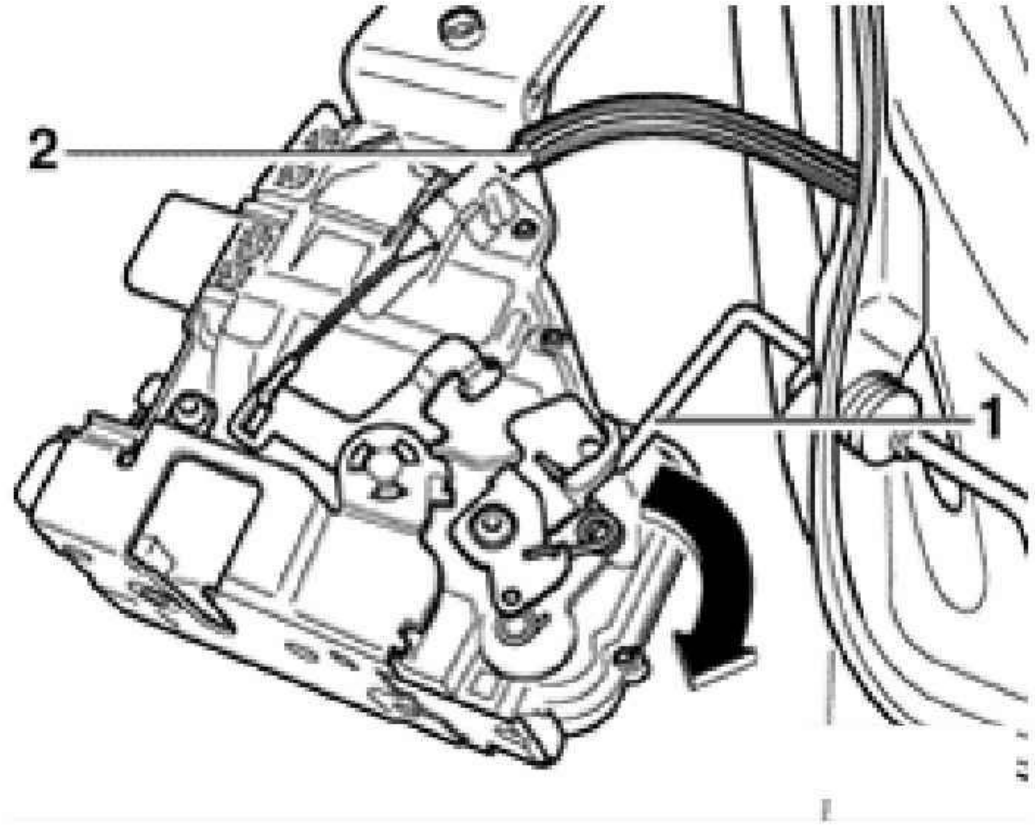

Fig. 152: Scan Tool Display - Activating & Deactivating Cruise Control System (3 Of 3)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press buttons -0- and -6- buttons to select "End output" function 06
- Press -Q- button to confirm input
- Switch ignition off and then on again.
- Switch ignition off.

Checking CCS activation/deactivation

- Connect VAG1551/1552 Scan Tool. See **VAG1551/1552 SCAN TOOL, CONNECTING** .
- Press buttons -0- and -1- to insert "Engine electronics" address word 01.

Indicated on display:

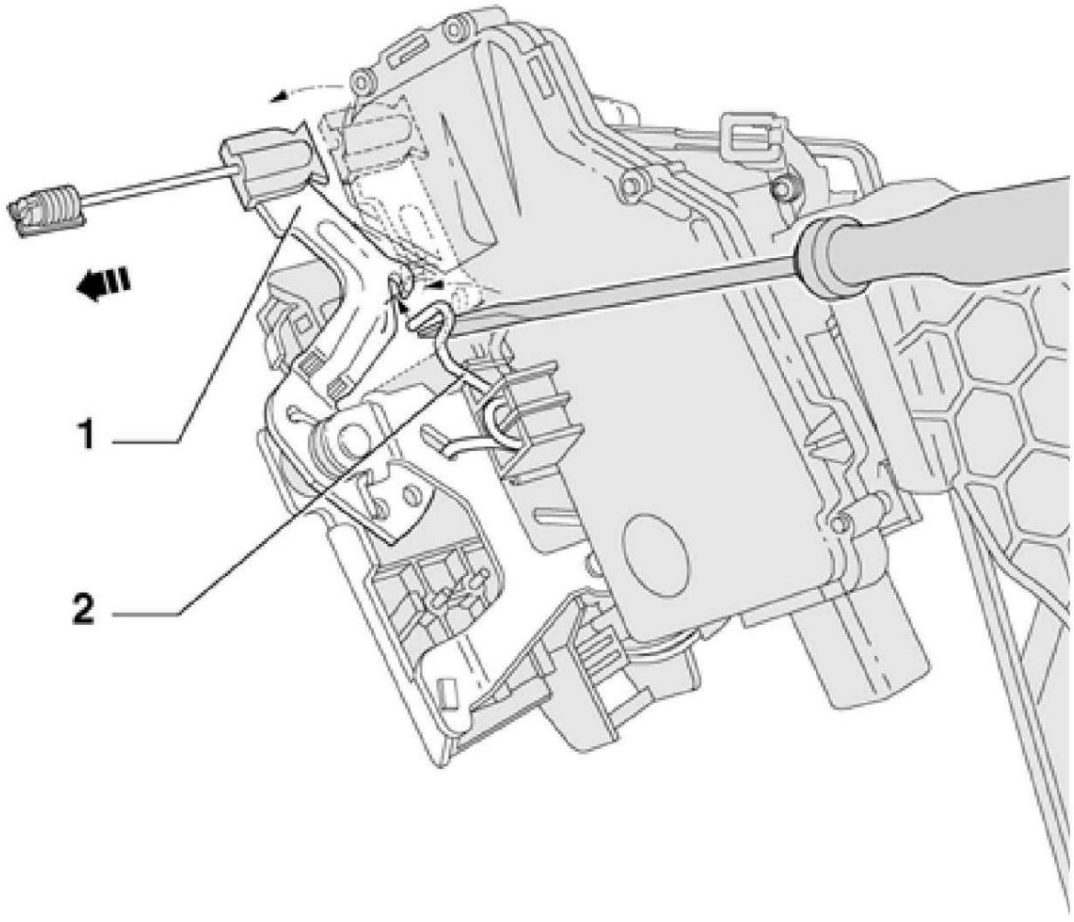

Fig. 153: Scan Tool Display - Checking CCS Activation/Deactivation (1 Of 3)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press buttons -0- and -8- to select Function 08 "Read measuring value block" function 08.
- Press -Q- button to confirm input

Indicated on display:

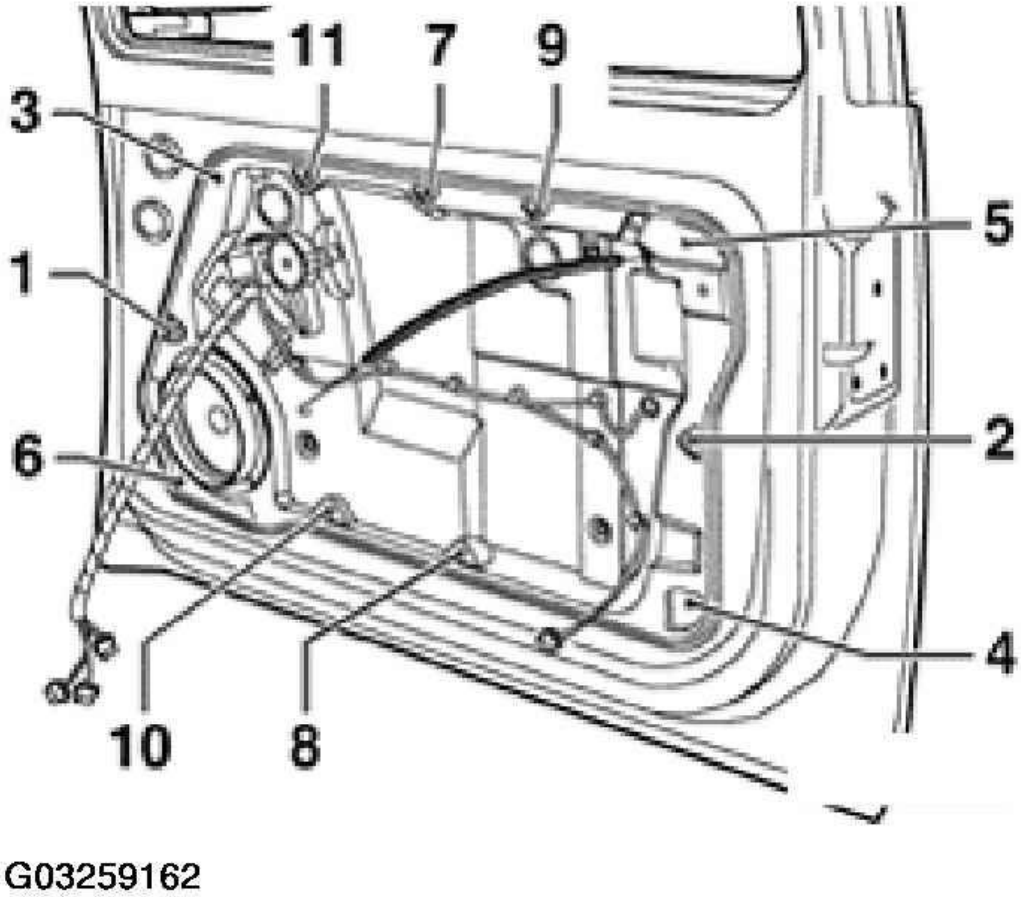

Fig. 154: Scan Tool Display - Checking CCS Activation/Deactivation (2 Of 3)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press buttons -0-, -0- and -6- to input display group number 006 and press -Q- button to confirm input.
- Check the specified value in display field 2:

Cruise Control Code Chart - Display Field 4

Value	Display field 4
0 or 1	cruise control system activated
255	cruise control system deactivated

- Press --> button

Indicated on display:

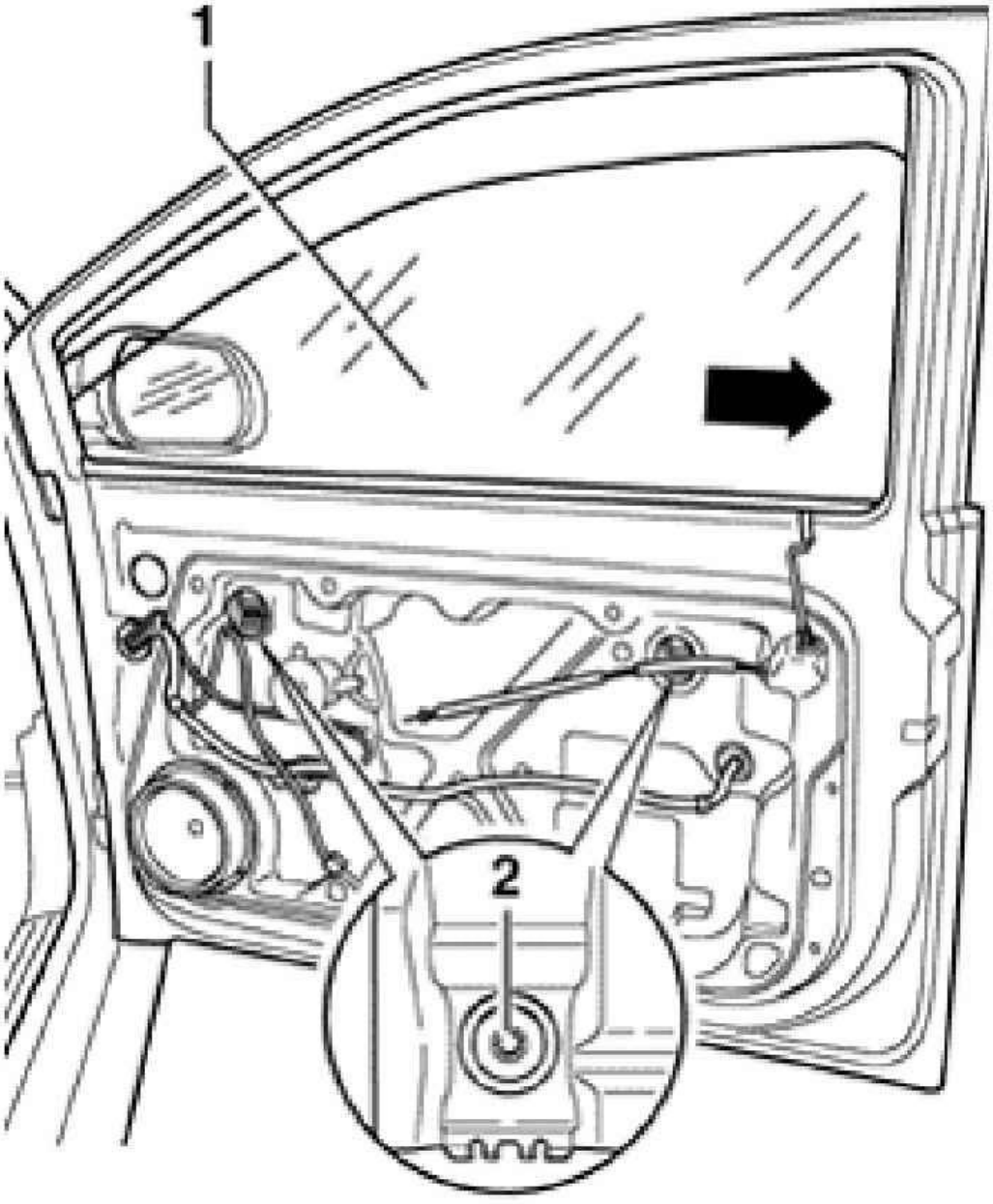

Fig. 155: Scan Tool Display - Checking CCS Activation/Deactivation (3 Of 3)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press buttons -0- and -6- buttons to select "End output" function 06

- Press -Q- button to confirm input
- Switch ignition off.

ADDITIONAL SIGNALS, CHECKING

Vehicle Speed signal, checking

The speed signal is required for A/C compressor cut-off when accelerating, for the Cruise Control System and to improve driveability smoothness (jolt damping).

Special tools

- VAG1551/1552 Scan Tool using VAG1551/3 Adapter cable
- VAG1598/22 Test Box (MY 1999)
- VAG1598/31 Test Box (from MY 2000)
- VW 1594 Adapter kit
- VAG1527B Voltage tester
- Wiring diagram

Checking requirements

- Speedometer function and speedometer display OK.

> **WARNING: Secure Scan Tool to rear seat and operate from this position using a second technician.**

Test sequence

- Connect VAG1551/1552 Scan Tool. See **VAG1551/1552 SCAN TOOL, CONNECTING** .
- Start engine and let idle.
- Press -0- and -1- buttons to select Address word 01: "Engine electronics"

Display will appear as shown (example only):

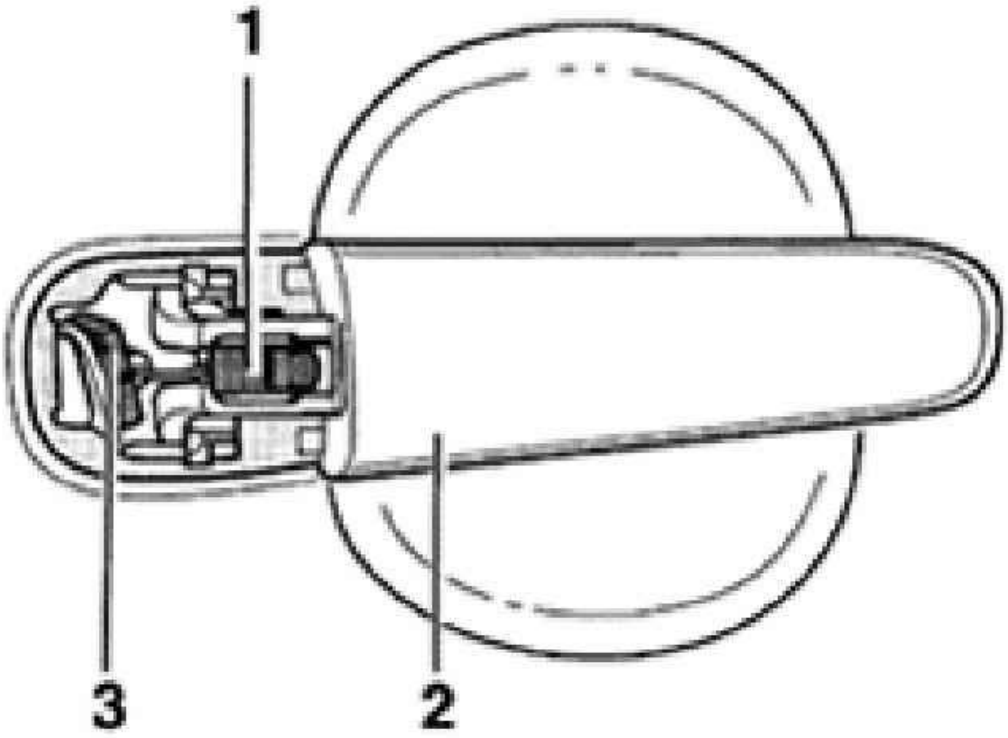

Fig. 156: Scan Tool Display - Vehicle Speed Signal (1 Of 4)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press --> button.

Display will appear as shown:

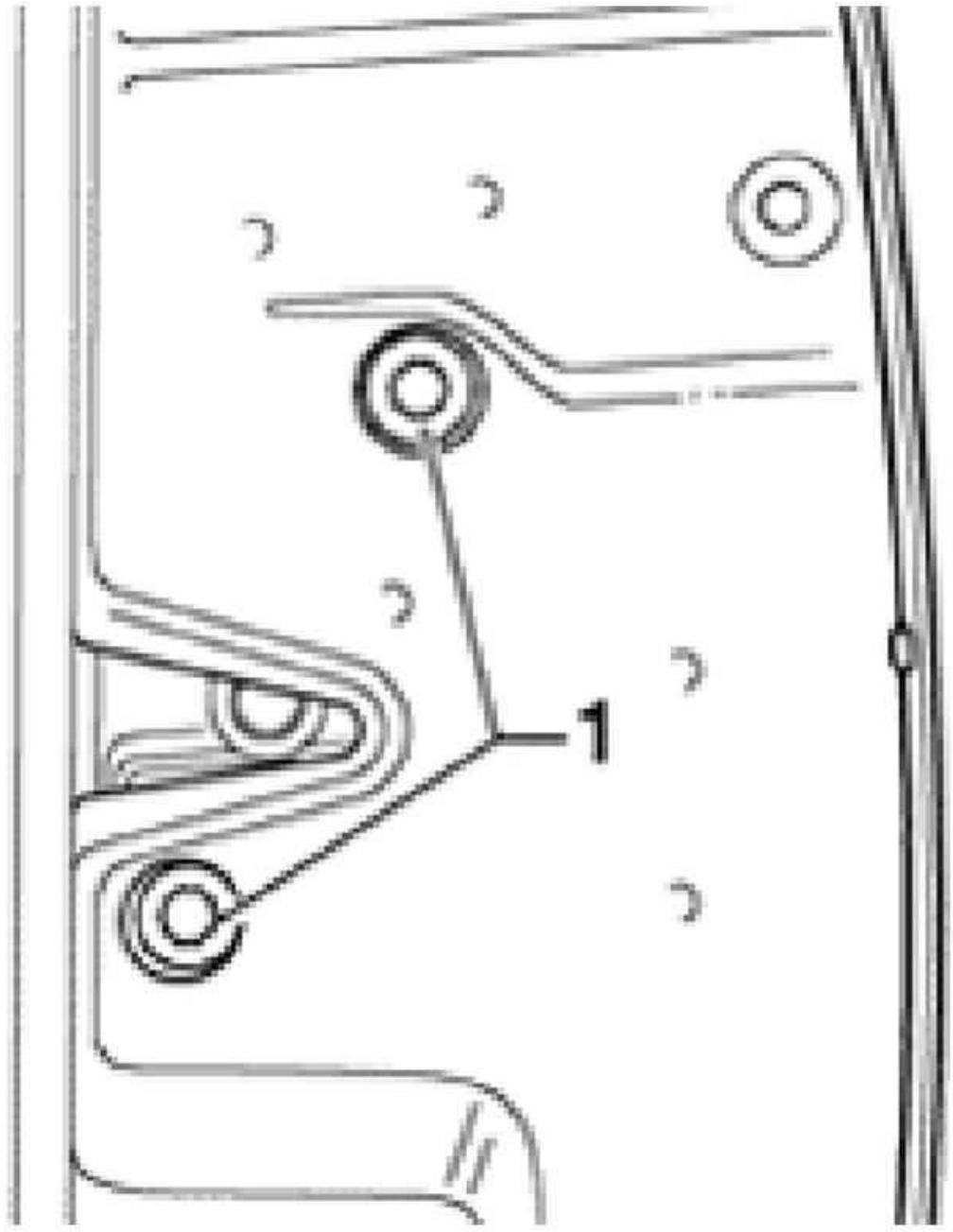

Fig. 157: Scan Tool Display - Vehicle Speed Signal (2 Of 4)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -8- buttons to select Function 08: "Read measuring value block".
- Press -Q- button to enter input.

Display will appear as shown:

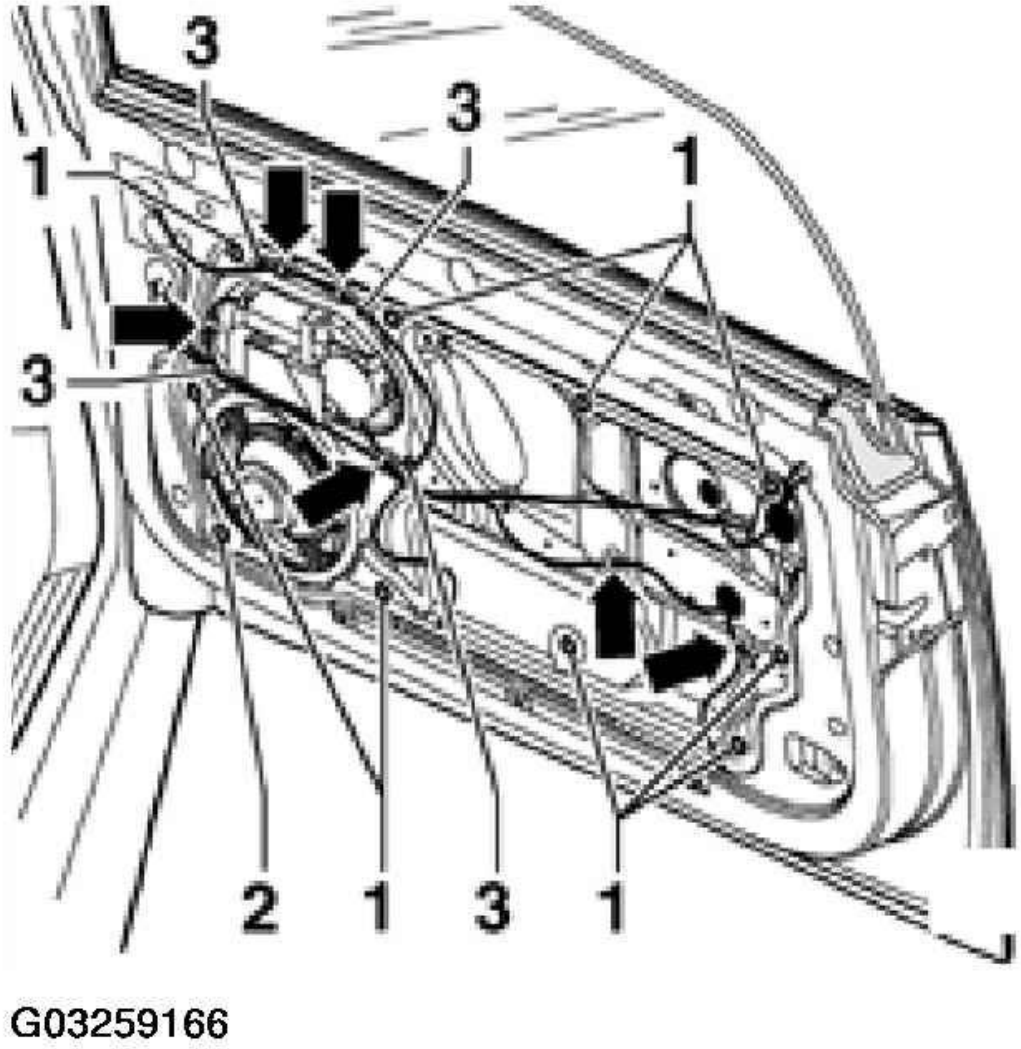

Fig. 158: Scan Tool Display - Vehicle Speed Signal (3 Of 4)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0-, -0- and -6- buttons to select "Display group 6".
- Press -Q- button to enter input.

Display will appear as shown (1 to 4 = Display zones):

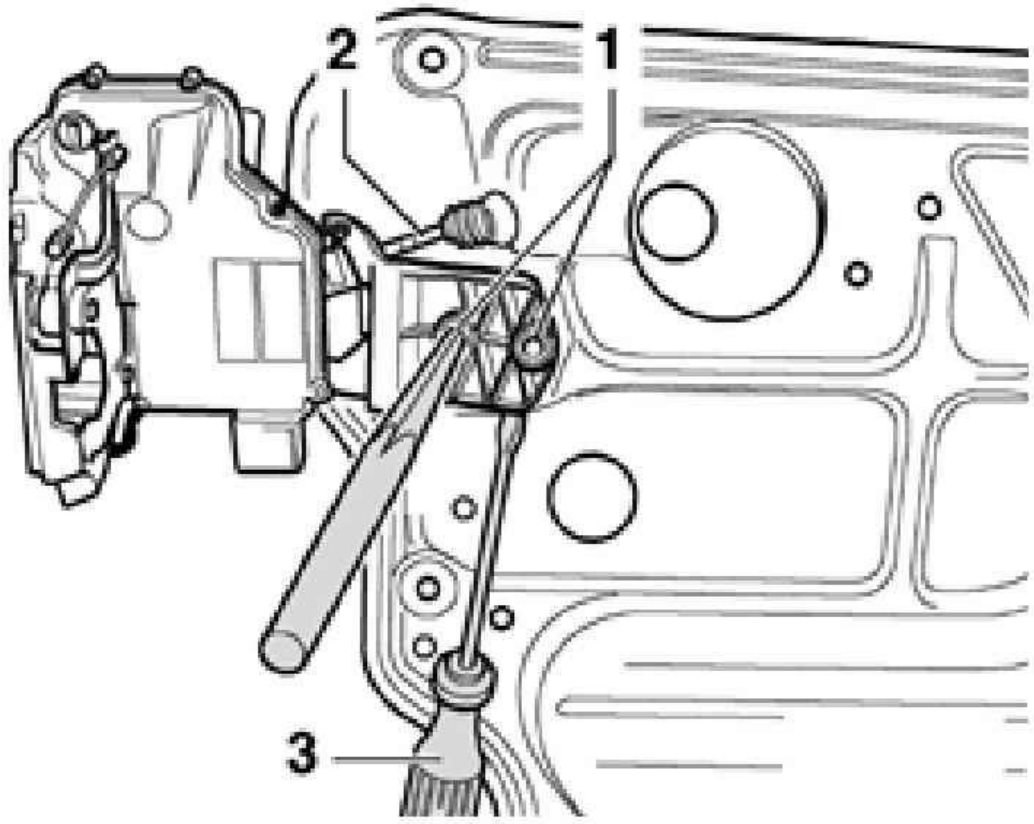

Fig. 159: Scan Tool Display - Vehicle Speed Signal (4 Of 4)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Take a test drive using a 2nd technician to observe display.
- Observe value in Display zone 1
- Specification: approx. speedometer display

If no speed indicated:

- Connect VAG1598/22 (or 1598/31) Test Box to ECM wiring harness.

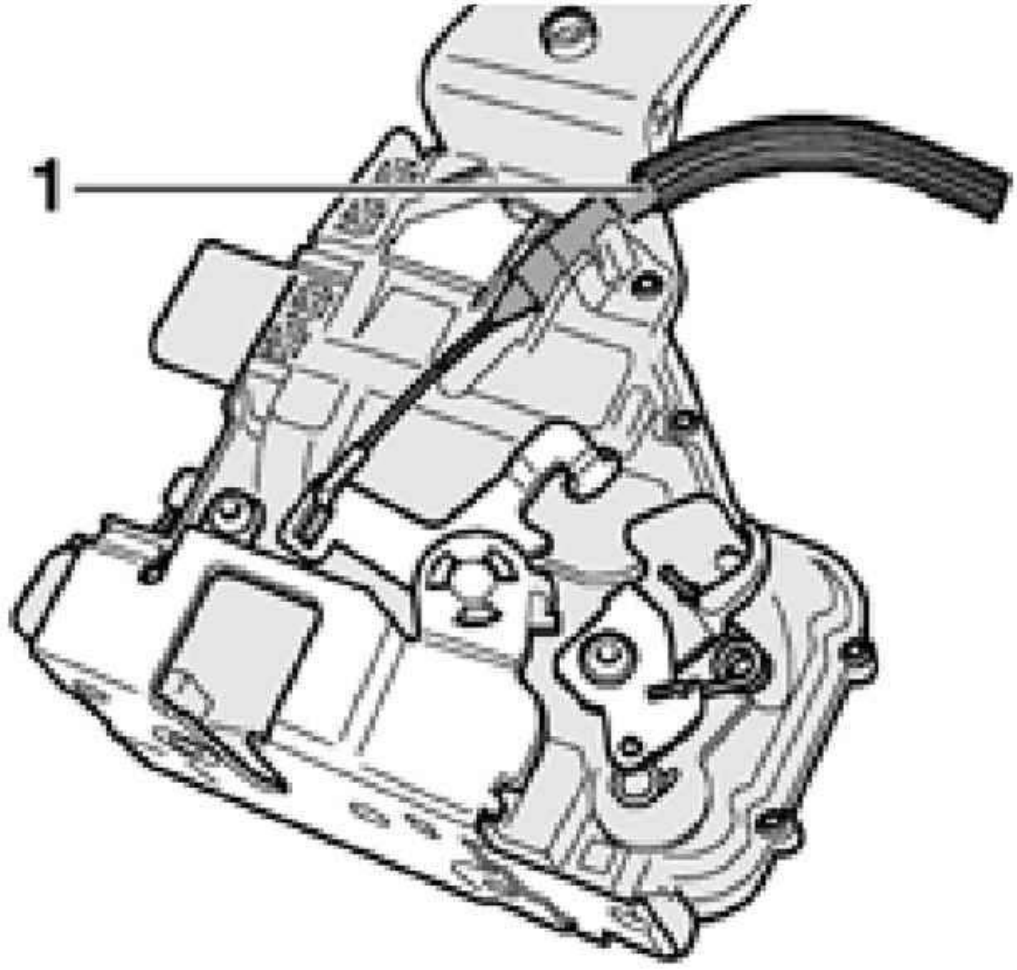

Fig. 160: Connecting VAG1598/22 (Or 1598/31) Test Box To ECM Wiring Harness
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Connect LED test light between sockets:

Up to MY 1999

- 1 (Ground) and 51 (road speed signal).

From MY 2000

- 4 (Ground) and 20 (road speed signal).
- Switch ON ignition and turn front left wheel by hand.
- Voltage tester LED must blink (approx. four times per wheel rotation)

NOTE: If necessary, hold the front right wheel to prevent it from turning.

If LED does not blink:

- Check wiring for open/short circuit between following ECM harness connector terminal and instrument cluster using Electrical Wiring Diagram.

See appropriate System Wiring Diagram article.

Up to MY 1999

Terminal 51

From MY 2000

Terminal 20

- Display the Readiness code. See **READINESS CODE, DISPLAYING** .

If DTC memory was erased:

- Set the readiness code. See **READINESS CODE, SETTING** .

Throttle Position (TP) sensor -G79-, checking up to MY 99

Throttle Position (TP) sensor -G79- is located on accelerator pedal and communicates physical pedal position to Diesel Direct Fuel Injection (DFI) Engine Control Module (ECM).

Special tools

- VAG1551/1552 Scan Tool using VAG1551/3 Adapter cable
- VAG1598/22 Test Box (MY 1999)
- VAG1598/31 Test Box (from MY 2000)
- Fluke 83 multimeter, or equivalent
- VW 1594 Adapter kit
- Electrical Wiring Diagrams, Troubleshooting & Component Locations

Test sequence

- Connect VAG1551/1552 Scan Tool. See **VAG1551/1552 SCAN TOOL, CONNECTING** and switch ON ignition but do not start engine.
- Press -0- and -1- buttons to select Address word 01: "Engine electronics"

Display will appear as shown (example only):

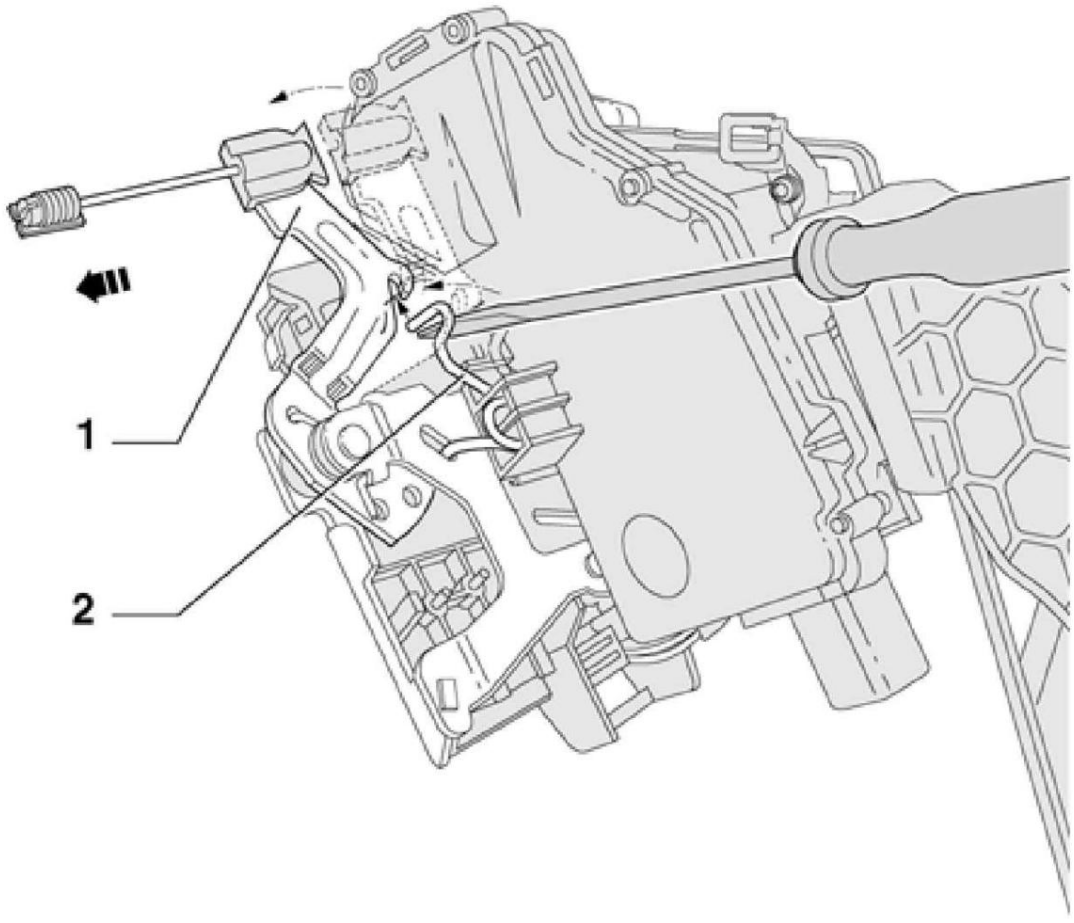

Fig. 161: Scan Tool Display - Throttle Position Sensor, Up To MY 99 (1 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press --> button.

Display will appear as shown:

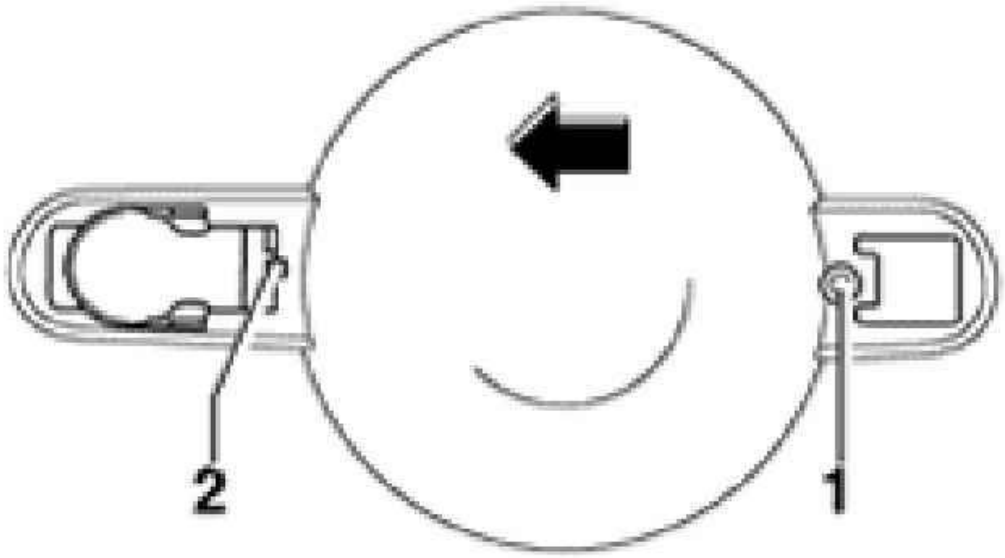

Fig. 162: Scan Tool Display - Throttle Position Sensor, Up To MY 99 (2 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -8- buttons to select Function 08: "Read measuring value block".
- Press -Q- button to enter input.

Display will appear as shown:

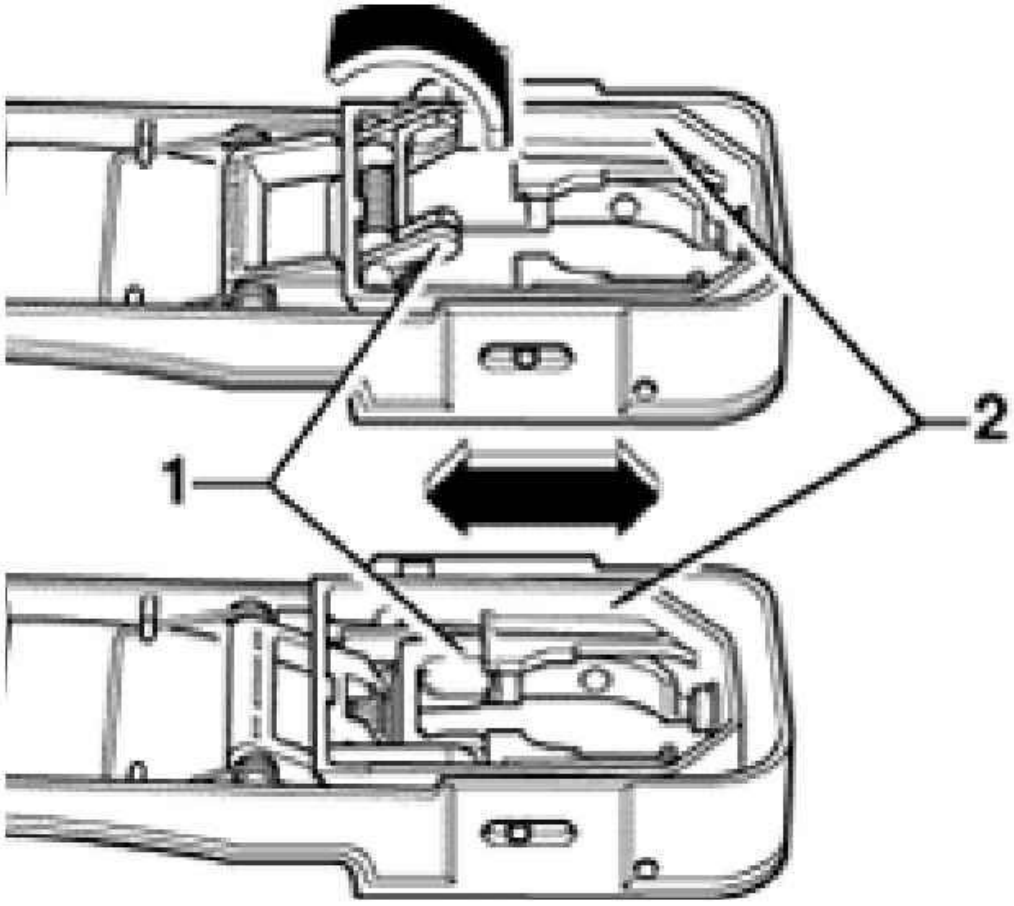

Fig. 163: Scan Tool Display - Throttle Position Sensor, Up To MY 99 (3 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press 0, 0 and 2 buttons to select "Display group 2".
- Press -Q- button to enter input.
- Observe value in Display zone 2 (Throttle Position).
- Specification: 0.0% (pedal not operated)

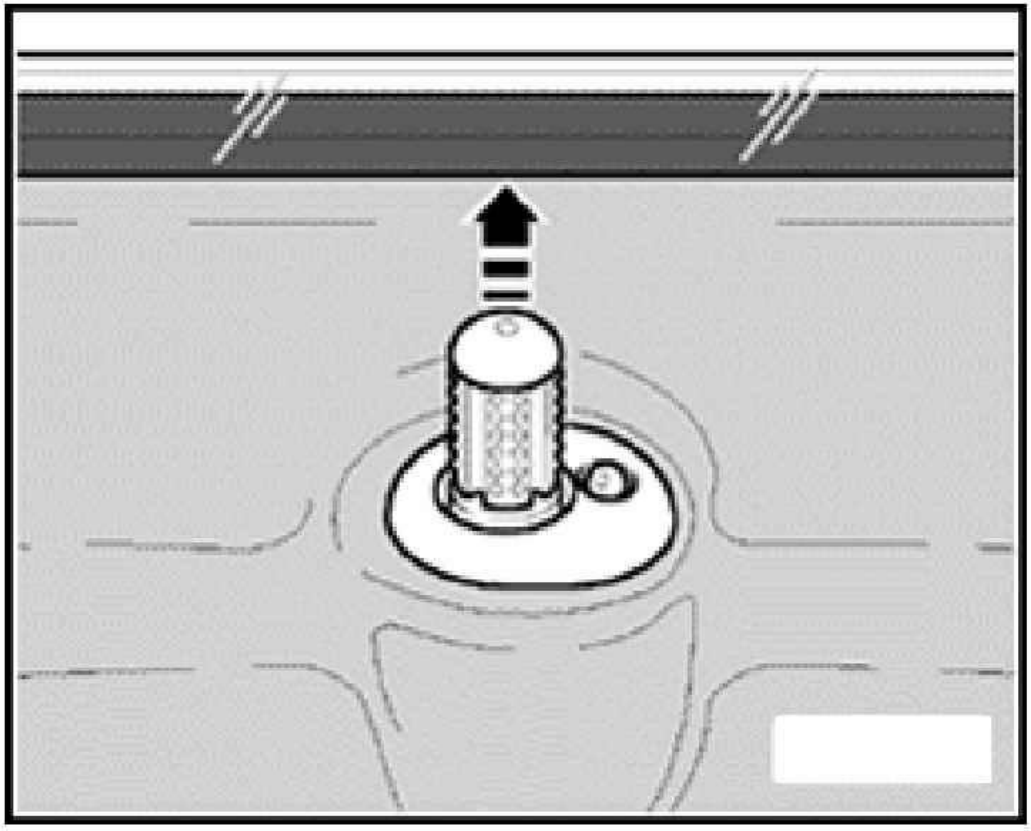

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Fig. 164: Scan Tool Display - Throttle Position Sensor, Up To MY 99 (4 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Observe value in Display zone 3.
- Specification:

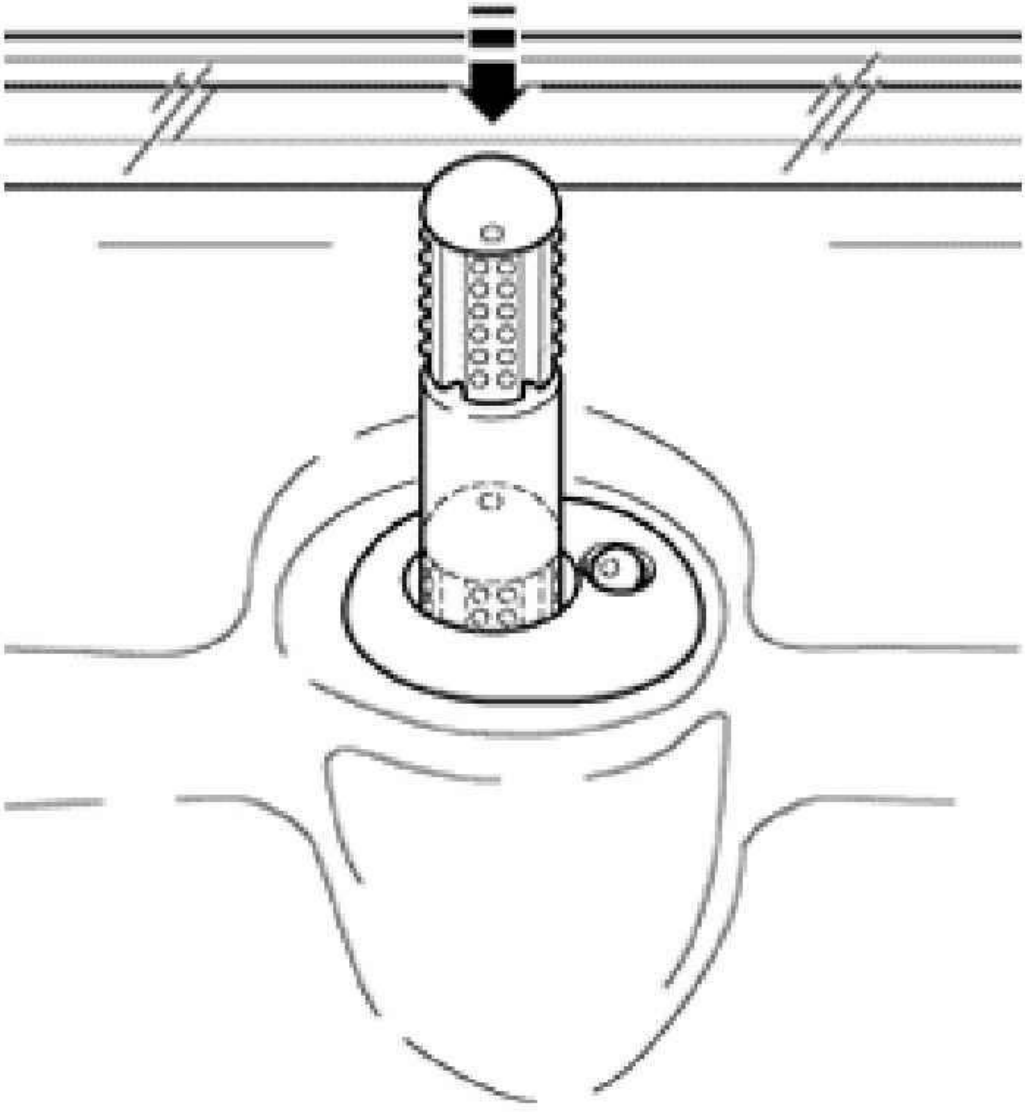


Fig. 165: Scan Tool Display - Throttle Position Sensor, Up To MY 99 (5 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

0 1 0 (pedal not operated)

0 0 0 (pedal operated)

- Press accelerator pedal down slowly.

- Specification: value in zone 2 must increase steadily up to 100% (pedal fully depressed).

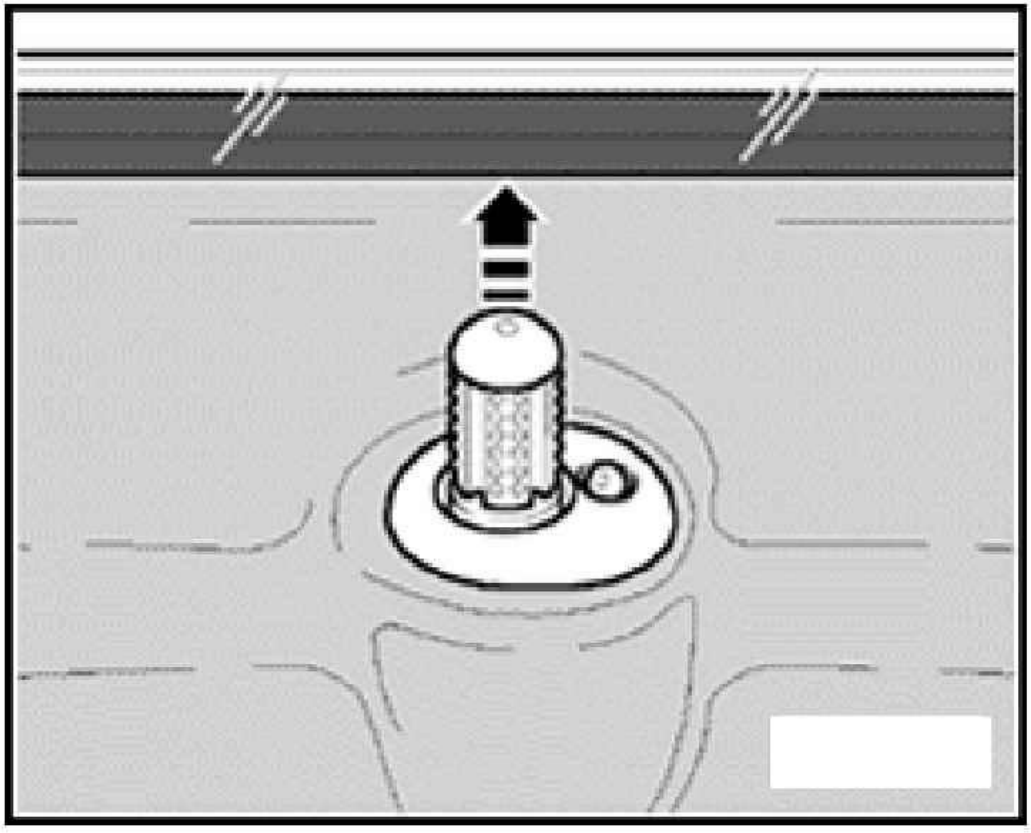


Fig. 166: Scan Tool Display - Throttle Position Sensor, Up To MY 99 (6 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

On vehicles with an automatic transmission, the kickdown switch pressure point must be distinctly felt before the Wide Open Throttle (WOT) stop position is reached.

If specified end value not reached:

- Adjust Throttle Position sensor -G79-

If display does not change or is irregular:

- Check Throttle Position sensor as follows:
- Switch OFF ignition.

- Disconnect connector for sensor: Component locations overview. See **DIESEL INJECTION SYSTEM, COMPONENT LOCATIONS OVERVIEW** .
- Carry out resistance measurement between sensor terminals 1 and 3 using Fluke 83 multimeter.

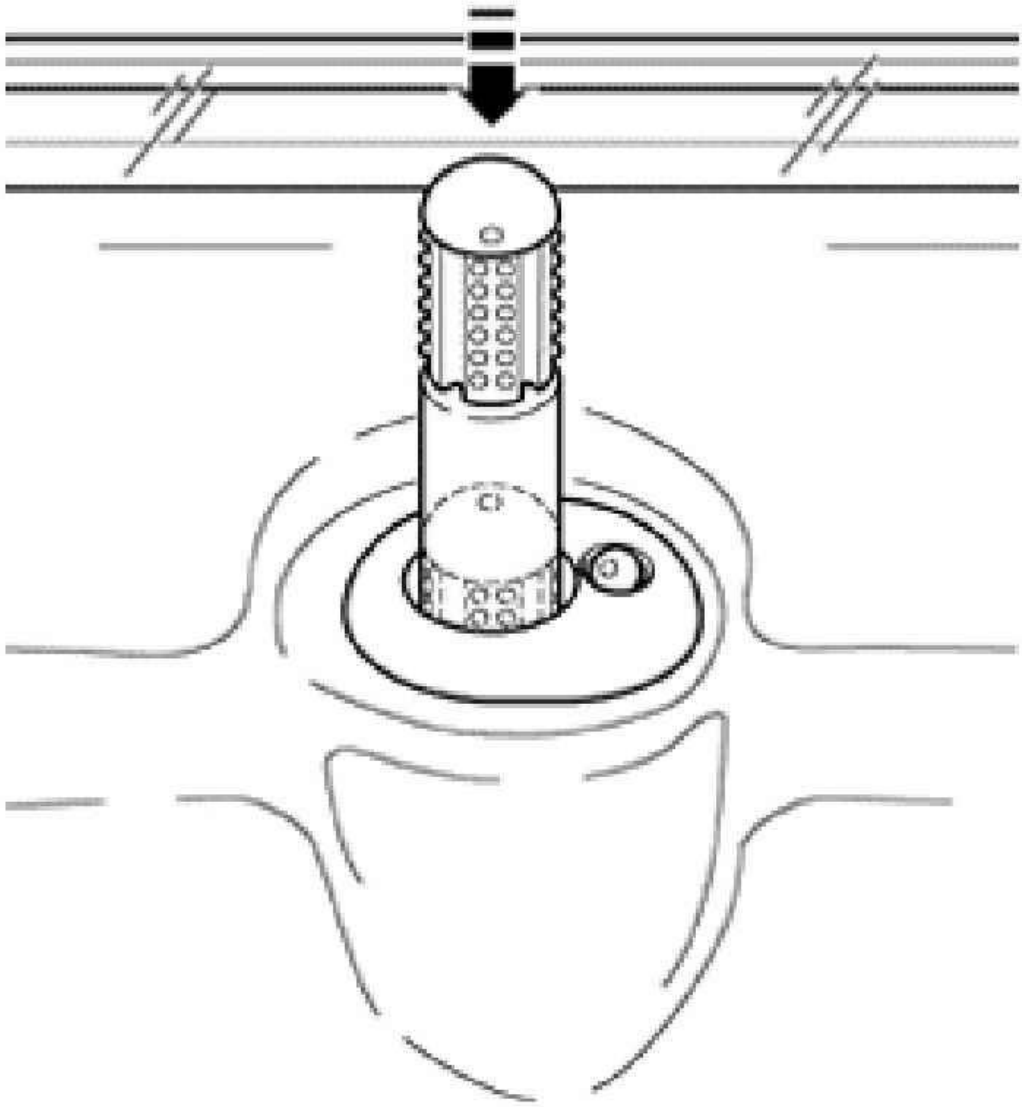


Fig. 167: Identifying Throttle Position Sensor Terminals (Up To MY 99)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Accelerator not depressed: Idling speed

    - Specification: 1.0 to 1.5 k ohm

- Accelerator depressed: wide open throttle
    - Specification: 1.5 to 2.5 k ohm

If specifications not obtained:

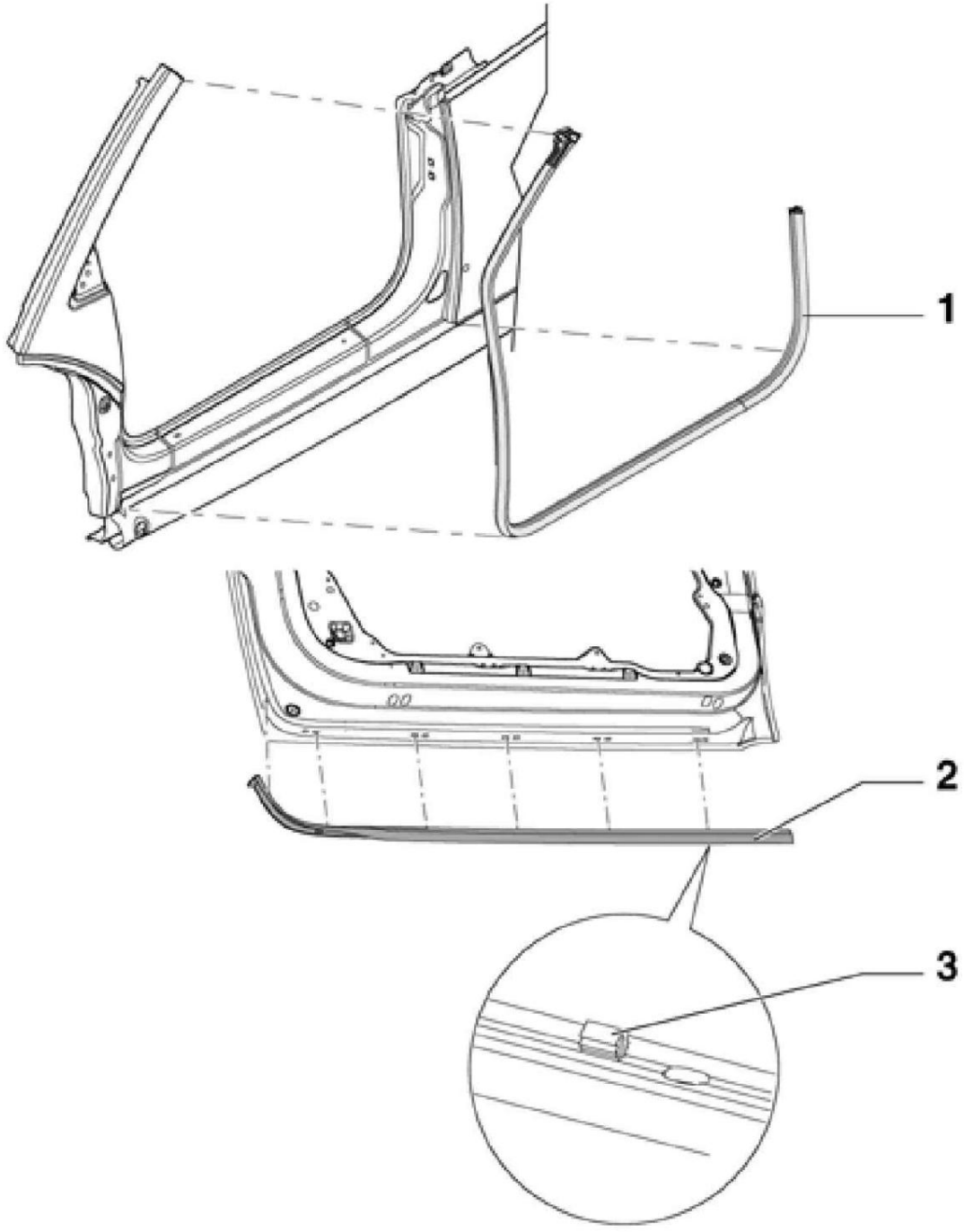
- Replace Throttle Position sensor -G79-.
- Display the Readiness code. See **READINESS CODE, DISPLAYING** .

If DTC memory was erased:

- Set the readiness code. See **READINESS CODE, SETTING** .

If specifications obtained:

- Switch OFF ignition.
- Disconnect harness connector for sensor. See **DIESEL INJECTION SYSTEM, COMPONENT LOCATIONS OVERVIEW** .
- Connect VAG1598/22 (or 1598/31) Test Box to ECM wiring harness.



1 - Door inner seal

2 - Dust seal

3 - Clip

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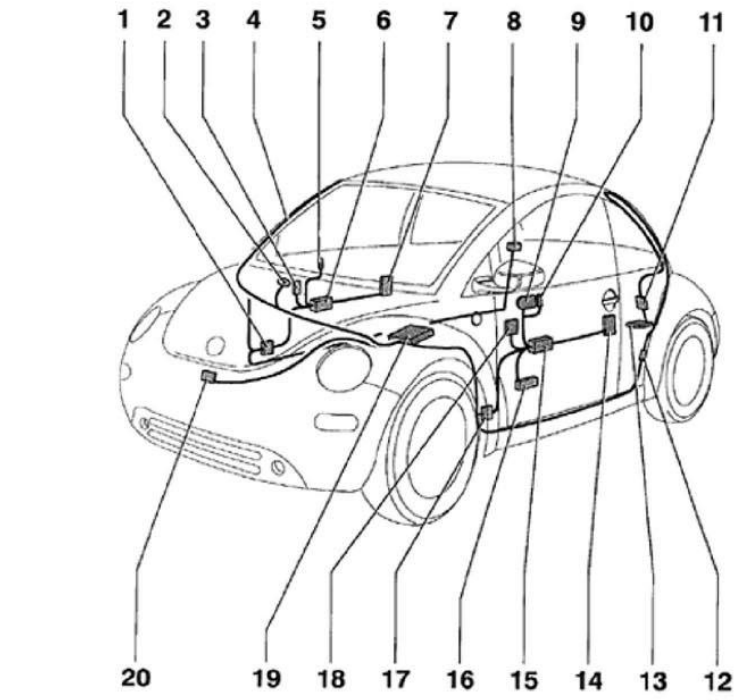
Fig. 168: Connecting VAG1598/22 (Or 1598/31) Test Box To ECM Wiring Harness (Up To MY 99)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check following combinations for open circuits and/or short to positive or negative:



1 - Coupling station
2 - Anti-theft alarm horn
3 - Front right power window switch
4 - Aerial for remote control
5 - Interior locking switch, front passenger's side
6 - Front right door control unit
7 - Front right door lock
8 - Motor for fuel tank lid unlock V155
9 - Exterior mirror adjustment switch and change-over switch
10 - Interior locking switch, driver's side
11 - Tailgate/trunk lid remote release motor
12 - Coupling station
13 - Hood lock
14 - Front left door lock
15 - Front left door control unit
16 - Controls
17 - Coupling station
18 - Power window switch
19 - Central control unit
20 - Hood lock

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Fig. 169: Identifying Throttle Position Sensor Harness Connector Terminals (Up To MY 99) Courtesy of VOLKSWAGEN OF AMERICA, INC.

Up to MY 1999

- Wiring between connector terminal 1 and Test Box socket 24.
- Wiring between connector terminal 2 and Test Box socket 11.
- Wiring between connector terminal 3 and Test Box socket 23.
- Wiring between connector terminal 4 and Test Box socket 12.
- Wiring between connector terminal 5 and Test Box socket 8.
- Wiring between connector terminal 6 and Test Box socket 25.

From MY 2000

- Wiring between connector terminal 1 and Test Box socket 63.
- Wiring between connector terminal 2 and Test Box socket 12.
- Wiring between connector terminal 3 and Test Box socket 50.
- Wiring between connector terminal 4 and Test Box socket 69.
- Wiring between connector terminal 5 and Test Box socket 70.
- Wiring between connector terminal 6 and Test Box socket 51.

- Correct any open/short circuit as required.

If neither an open or short circuit exists:

- Replace Engine Control Module -J248-.
- Display the Readiness code. See **READINESS CODE, DISPLAYING** .

If DTC memory was erased:

- Set the readiness code. See **READINESS CODE, SETTING** .

Throttle Position (TP) sensor -G79-, checking from MY 99

Throttle Position (TP) sensor -G79- is located on accelerator pedal and communicates physical pedal position to Diesel Direct Fuel Injection (DFI) Engine Control Module (ECM).

Special tools

- VAG1551/1552 Scan Tool with VAG1551/3 Adapter cable
- VAG1598/22 Test Box (MY 1999)
- VAG1598/31 Test Box (from MY 2000)
- Fluke 83 multimeter, or equivalent
- VW 1594 Adapter kit
- Electrical Wiring Diagrams, Troubleshooting & Component Locations

Test sequence

- Switch ON ignition but do not start engine.
- Press -0- and -1- buttons to select Address word 01: "Engine electronics"

Display will appear as shown (example only):

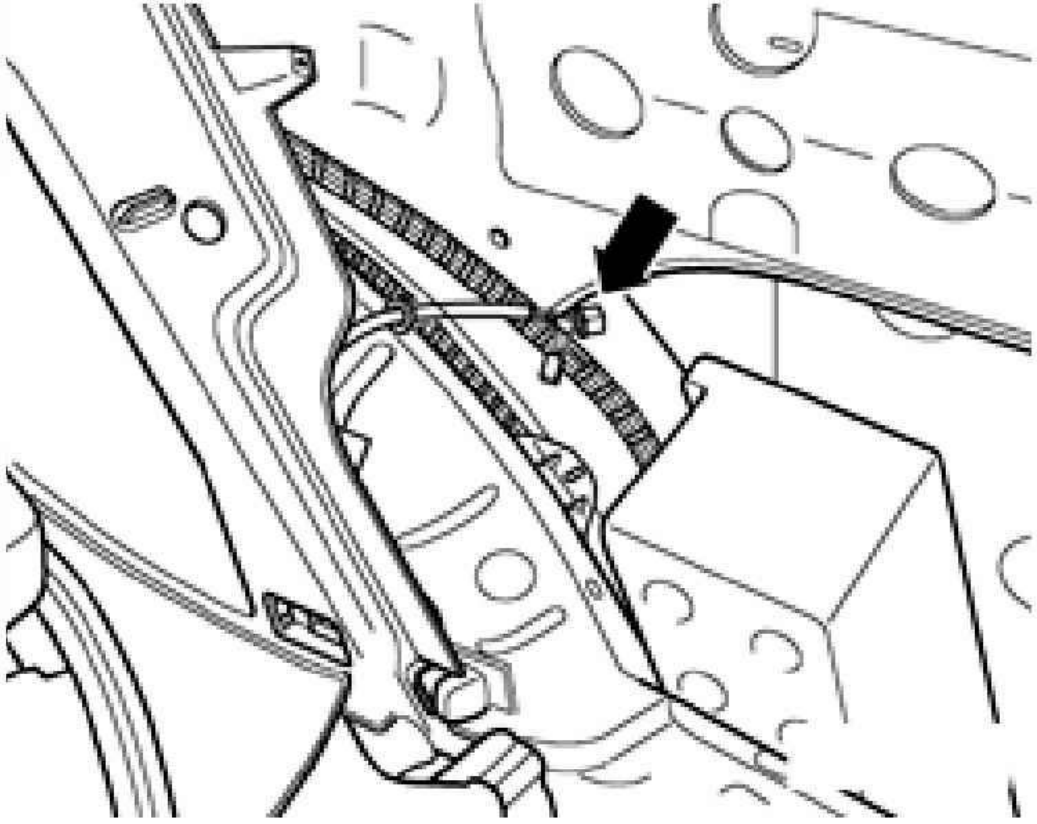

Fig. 170: Scan Tool Display - Throttle Position Sensor, From MY 99 (1 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press --> button.

Display will appear as shown:

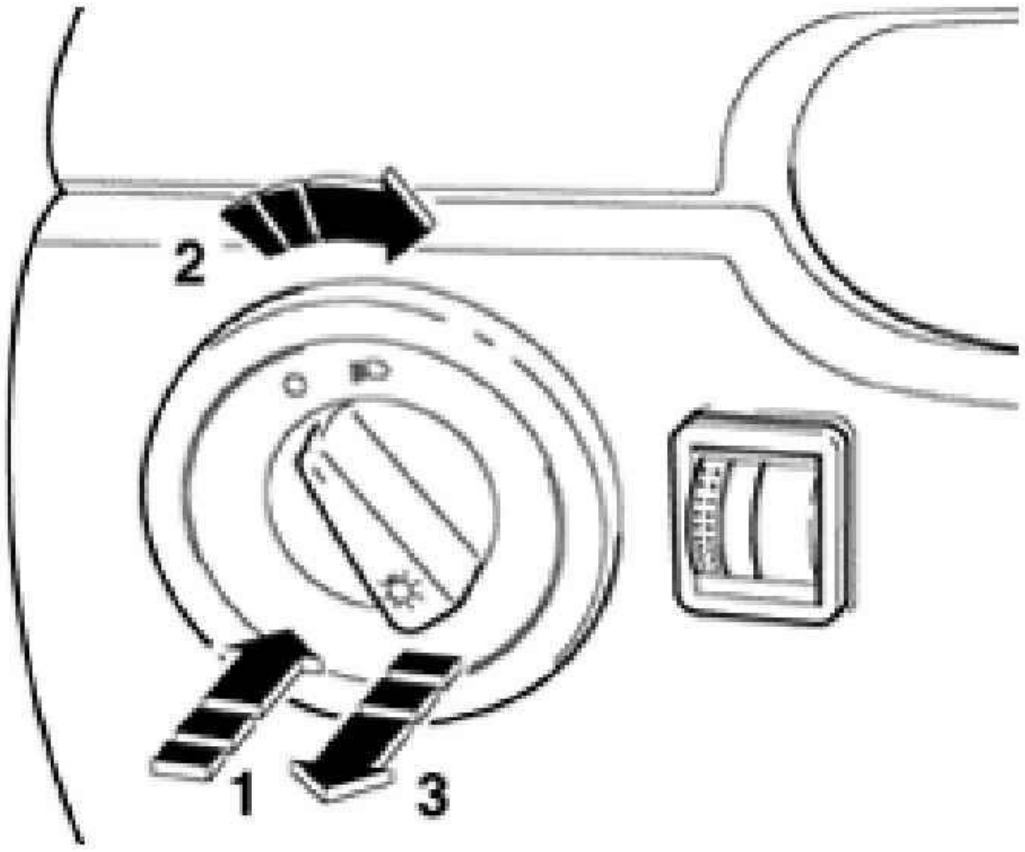

Fig. 171: Scan Tool Display - Throttle Position Sensor, From MY 99 (2 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -8- buttons to select Function 08: "Read measuring value block".
- Press -Q- button to enter input.

Display will appear as shown:

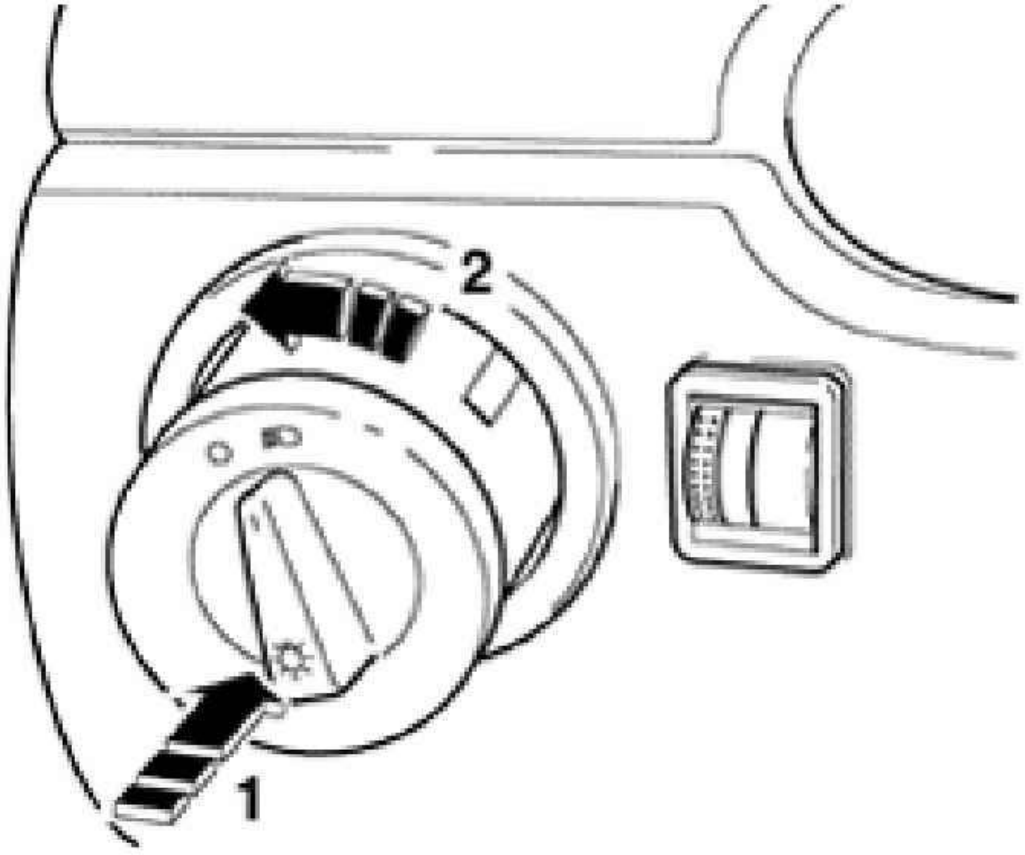

Fig. 172: Scan Tool Display - Throttle Position Sensor, From MY 99 (3 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press 0, 0 and 2 buttons to select "Display group 2".
- Press -Q- button to enter input.
- Observe value in Display zone 2 (Throttle Position).
- Specification: 0.0% (pedal not operated)

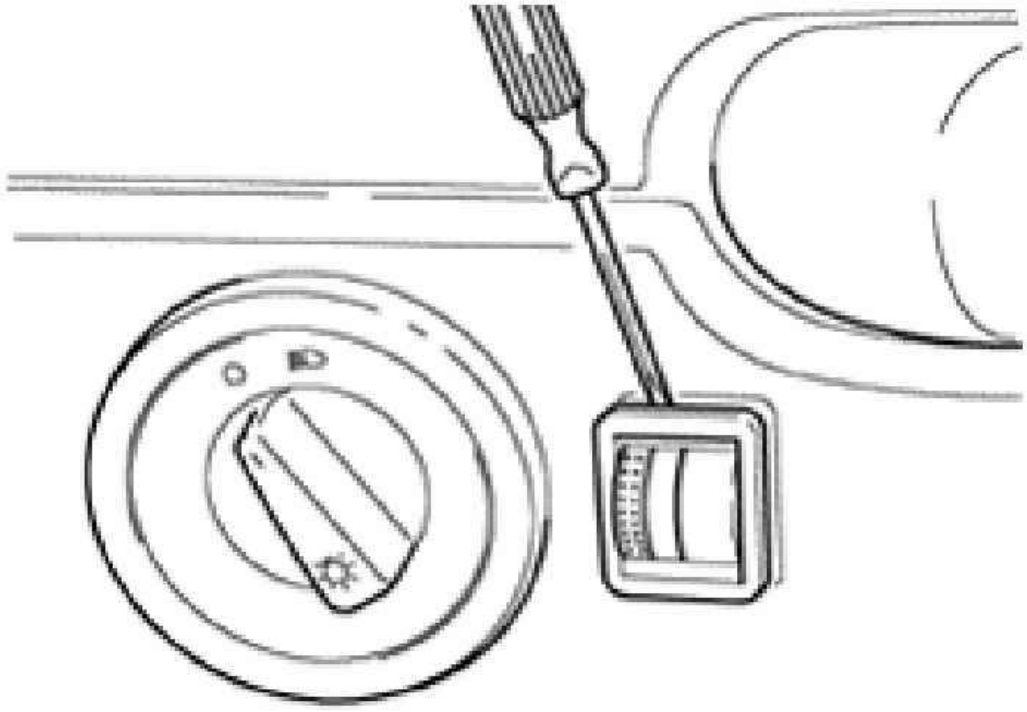

Fig. 173: Scan Tool Display - Throttle Position Sensor, From MY 99 (4 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Observe value in Display zone 3.
- Specification:

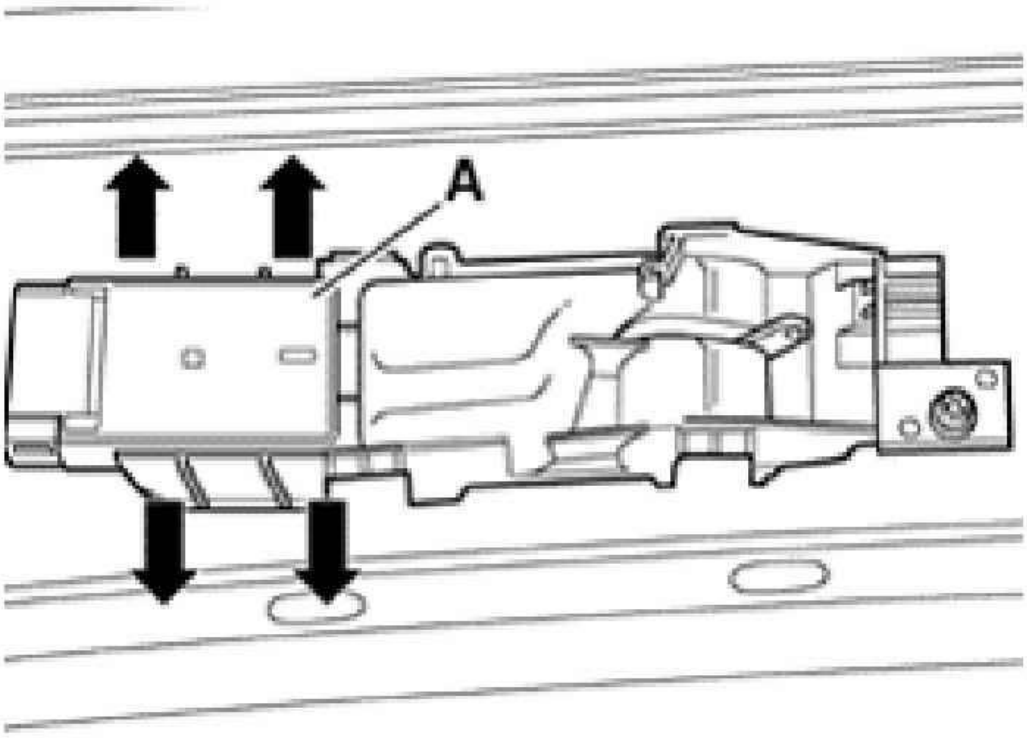

Fig. 174: Scan Tool Display - Throttle Position Sensor, From MY 99 (5 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

0 1 0 (pedal not operated)

0 0 0 (pedal operated)

- Press accelerator pedal down slowly.
- Specification: value in zone 2 must increase steadily up to 100% (pedal fully depressed).

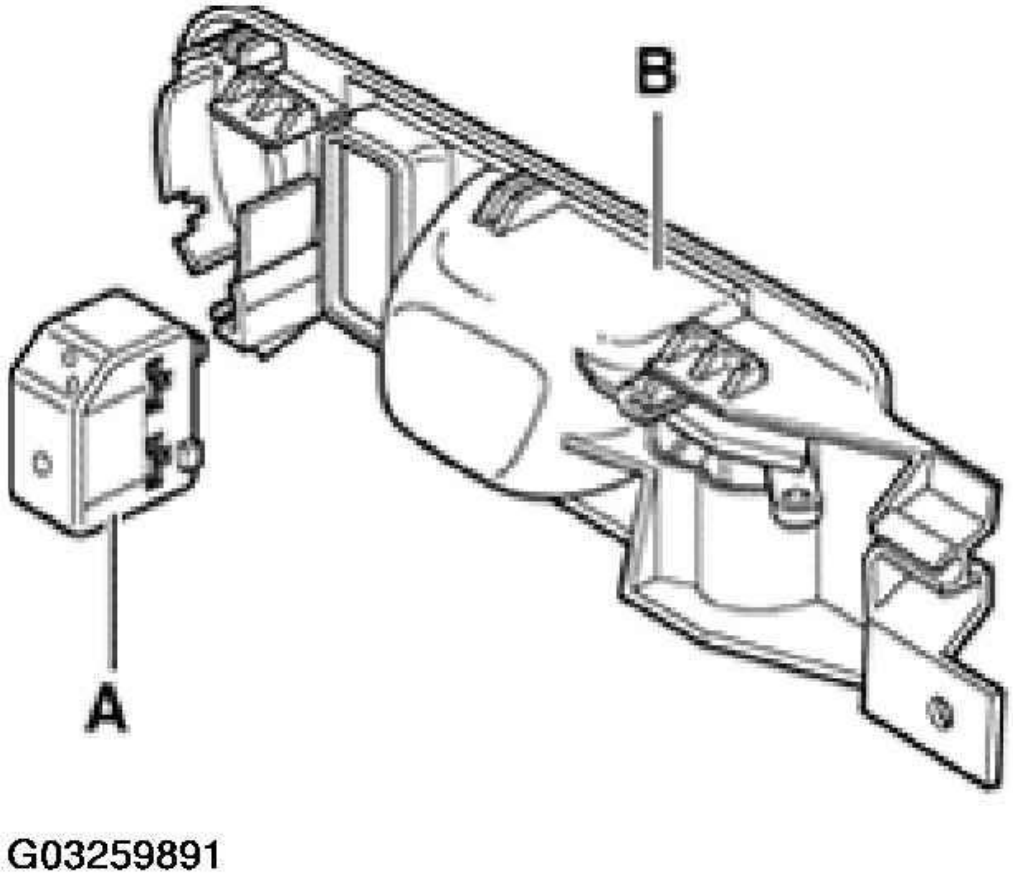

Fig. 175: Scan Tool Display - Throttle Position Sensor, From MY 99 (6 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

On vehicles with an automatic transmission, the kickdown switch pressure point must be distinctly felt before the Wide Open Throttle (WOT) stop position is reached.

If specified end value not reached:

- Replace Throttle Position sensor -G79-

If display does not change or is irregular:

- Check Throttle Position sensor as follows:
- Switch OFF ignition.
- Disconnect harness connector for sensor. See **DIESEL INJECTION SYSTEM, COMPONENT**

LOCATIONS OVERVIEW .

- Connect VAG1598/22 (or 1598/31) Test Box to ECM wiring harness.

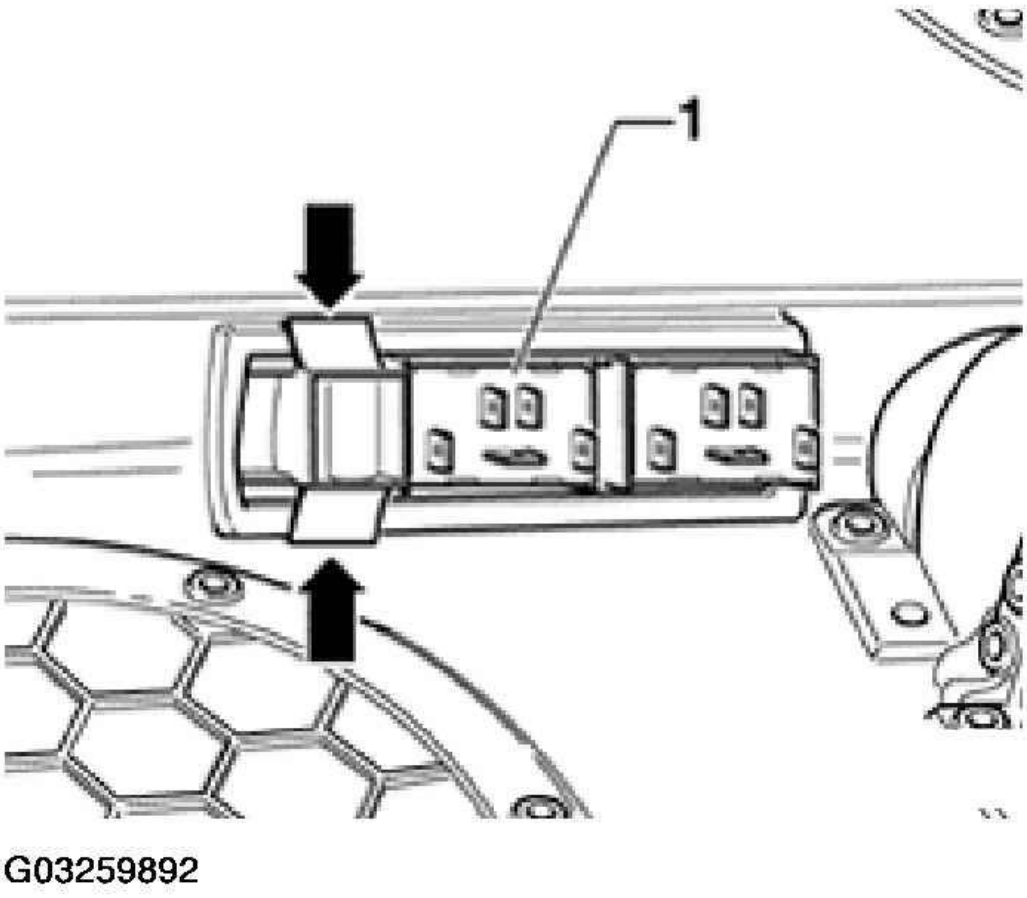

Fig. 176: Connecting VAG1598/22 (Or 1598/31) Test Box To ECM Wiring Harness (From MY 99)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Check following combinations for open circuits and/or short to positive or negative:

Fig. 177: Identifying Throttle Position Sensor Harness Connector Terminals (From MY 99)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Wiring between connector terminal 1 and Test Box socket 8.
- Wiring between connector terminal 2 and Test Box socket 11.
- Wiring between connector terminal 3 and Test Box socket 23.
- Wiring between connector terminal 4 and Test Box socket 24.
- Wiring between connector terminal 5 and Test Box socket 12.
- Wiring between connector terminal 6 and Test Box socket 25.
- Correct any open/short circuit as required.

If neither open nor short circuit exists:

- Replace Engine Control Module -J248-.

- Display the Readiness code. See **READINESS CODE, DISPLAYING** .

If DTC memory was erased:

- Set the readiness code. See **READINESS CODE, SETTING** .

Transmission range selector signal, checking

The Engine Control Module (ECM) receives the Transmission Range change signal from the Transmission Control Module (TCM) via the data bus. The ECM briefly reduces the injection quantity and thus reduces the torque and resulting shift jolt.

Special tools

- VAG1551/1552 Scan Tool using VAG1551/3 Adapter cable
- VAG1598/22 Test Box (MY 1999)
- VAG1598/31 Test Box (from MY 2000)
- Fluke 83 multimeter
- VW 1594 Adapter kit
- Wiring diagram

Test sequence

- Connect VAG1551/1552 Scan Tool. See **VAG1551/1552 SCAN TOOL, CONNECTING** and start engine and let idle.
- Press -0- and -1- buttons to select Address word 01: "Engine electronics"

Display will appear as shown (example only):

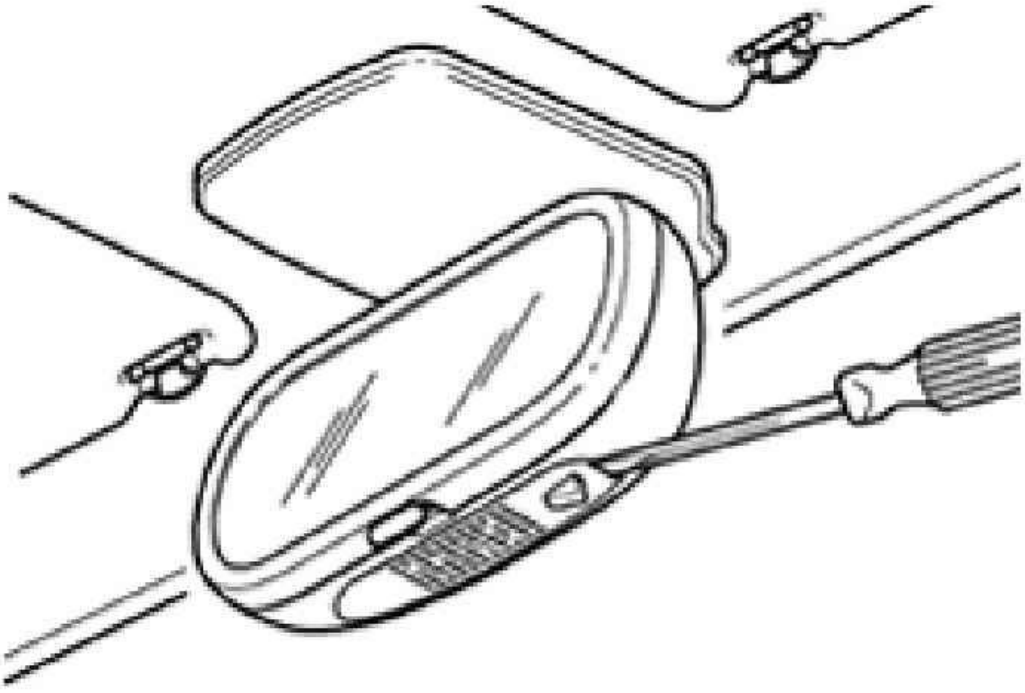

Fig. 178: Scan Tool Display - Transmission Range Selector Signal (1 Of 4)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press --> button.

Display will appear as shown:

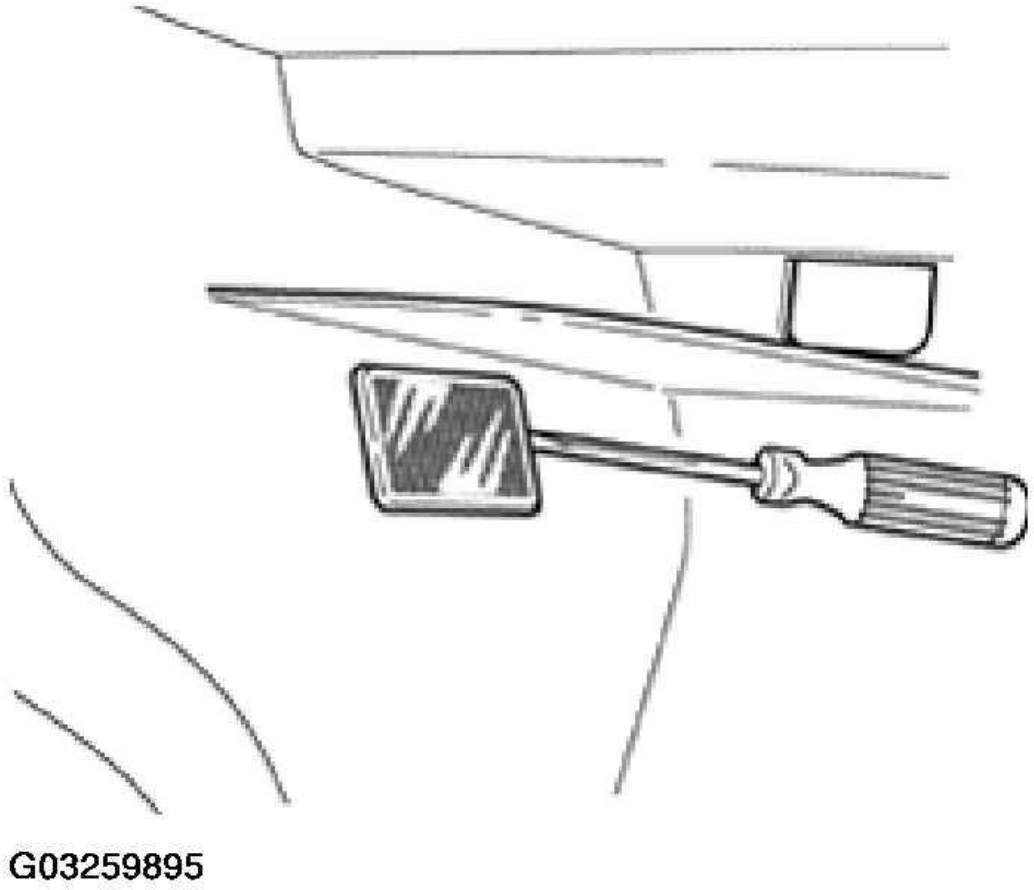

Fig. 179: Scan Tool Display - Transmission Range Selector Signal (2 Of 4)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -8- buttons to select Function 08: "Read measuring value block".
- Press -Q- button to enter input.

Display will appear as shown:

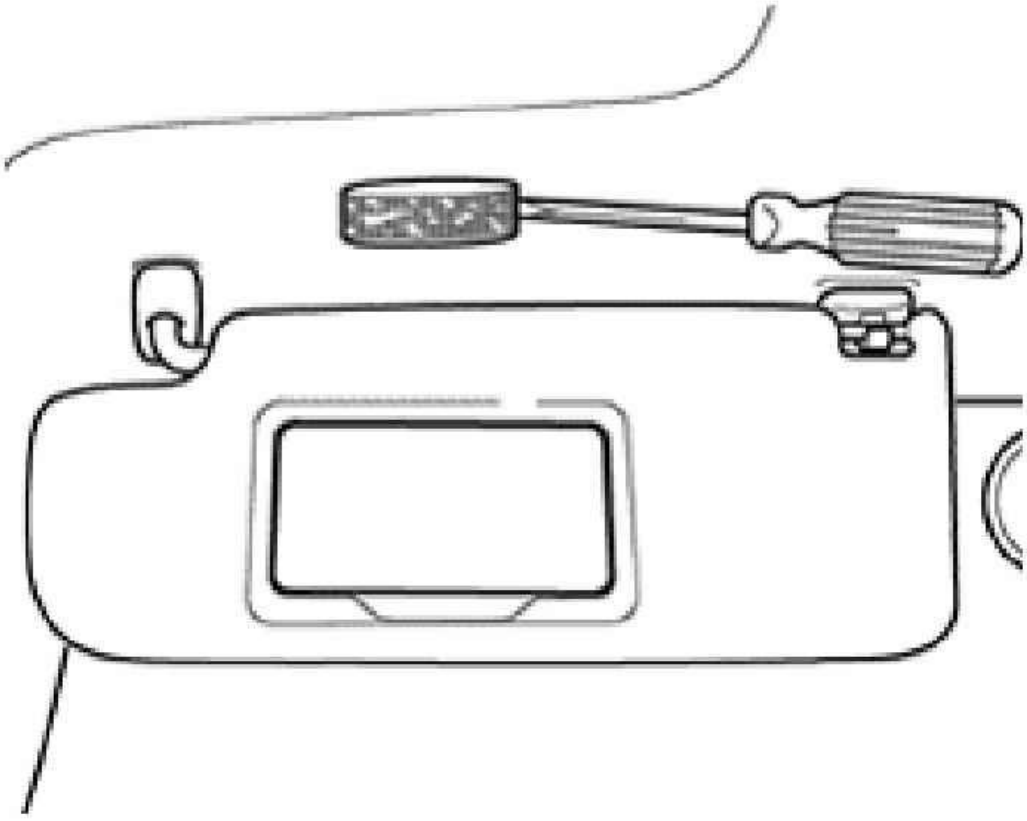

Fig. 180: Scan Tool Display - Transmission Range Selector Signal (3 Of 4)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0-, -0- and -9- buttons to select "Display group 9".
- Press -Q- button to enter input.

WARNING: Secure Scan Tool to rear seat and operate from this position using a second technician.

- Take a test drive and observe display using 2nd technician.
- Observe value in Display zone 3 when changing 2nd gear

- Specification: momentarily less than 51 mg/h

NOTE: Data transfer is slow, making it possible for delayed displays.

If specification not obtained:

- Press -> button.

Display will appear as shown:

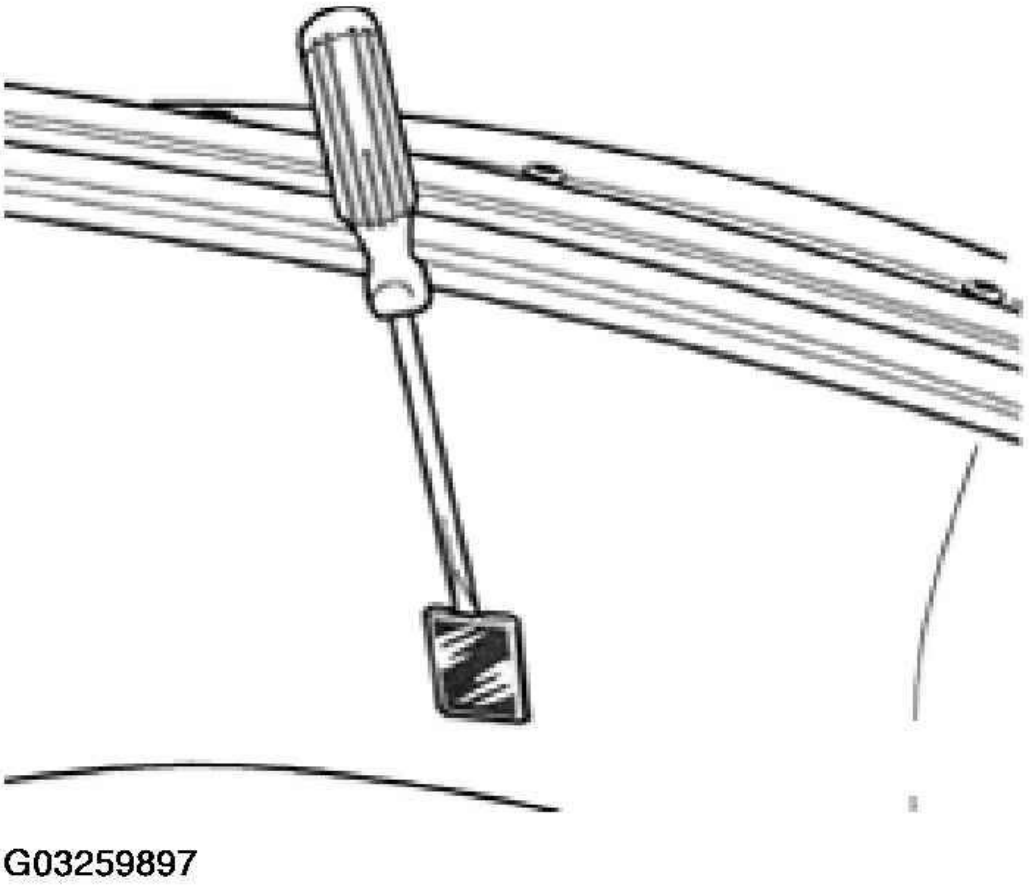

Fig. 181: Scan Tool Display - Transmission Range Selector Signal (4 Of 4)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -6- buttons to select Function 06: "End output".
- Press -Q- button to enter input.
- Switch OFF ignition.
- Connect VAG1598/22 (or 1598/31) Test Box to ECM wiring harness.

Fig. 182: Connecting VAG1598/22 (Or 1598/31) Test Box To ECM Wiring Harness
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check wiring between ECM and TCM for open / short circuits.

See appropriate System Wiring Diagram article.

A/C system signals, checking

Special tools

- VAG1551/1552 Scan Tool using VAG1551/3 Adapter cable
- VAG1598/22 Test Box (MY 1999)
- VAG1598/31 Test Box (from MY 2000)
- Fluke 83 multimeter
- VW 1594 Adapter kit
- Wiring diagram

Checking requirements

- A/C function OK
- No malfunctions stored in DTC memory. See **DTC MEMORY, CHECKING** .
- Vehicle temperature: +15 °C (59 °F) minimum
- A/C system switched ON

A/C compressor shut-off, checking

The A/C control head signals the Engine Control Module that the A/C compressor will be switched ON via the A/C compressor signal.

Using the same wiring, the A/C compressor is switched OFF by the ECM under the following circumstances:

- Hard acceleration from low speed
- Engine is running under an emergency program
- Engine Coolant Temperature exceeds +120 °C (248 °F)
- During every engine start for approx. 6 seconds.

Checking

- Connect VAG1551/1552 Scan Tool. See **VAG1551/1552 SCAN TOOL, CONNECTING** .
- Start engine and let idle.
- Press -0- and -1- buttons to select Address word 01: "Engine electronics"

Display will appear as shown (example only):

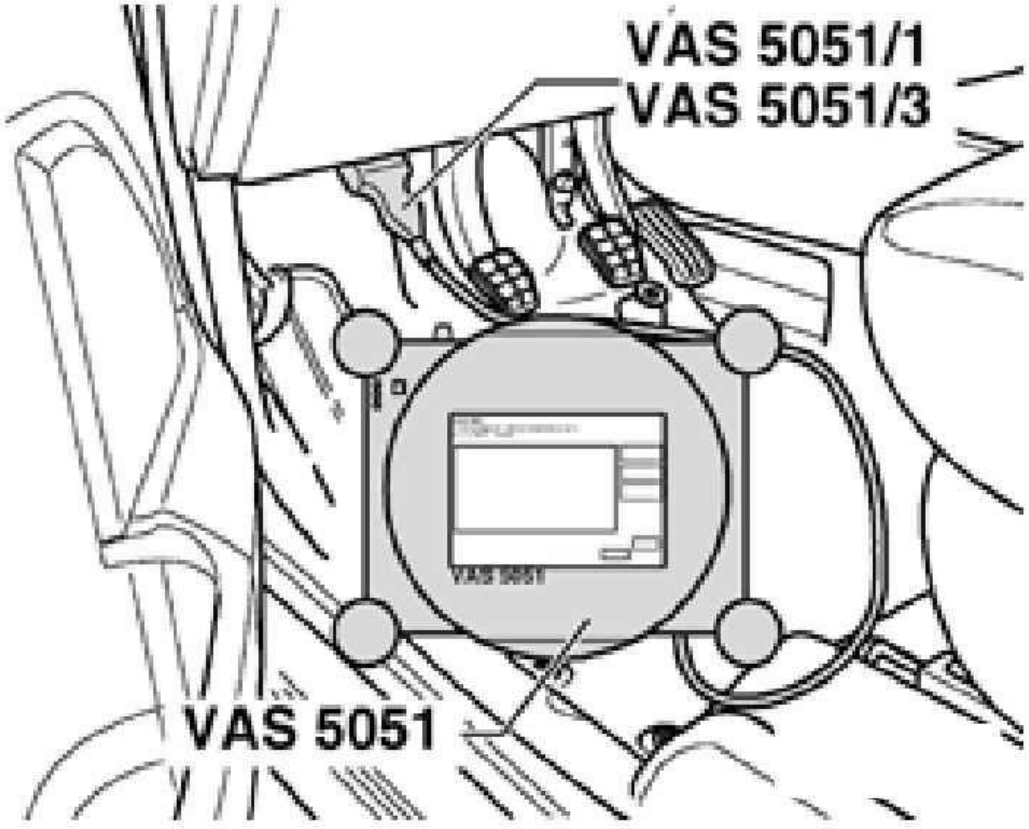

Fig. 183: Scan Tool Display - A/C System Signals (1 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press --> button.

Display will appear as shown:

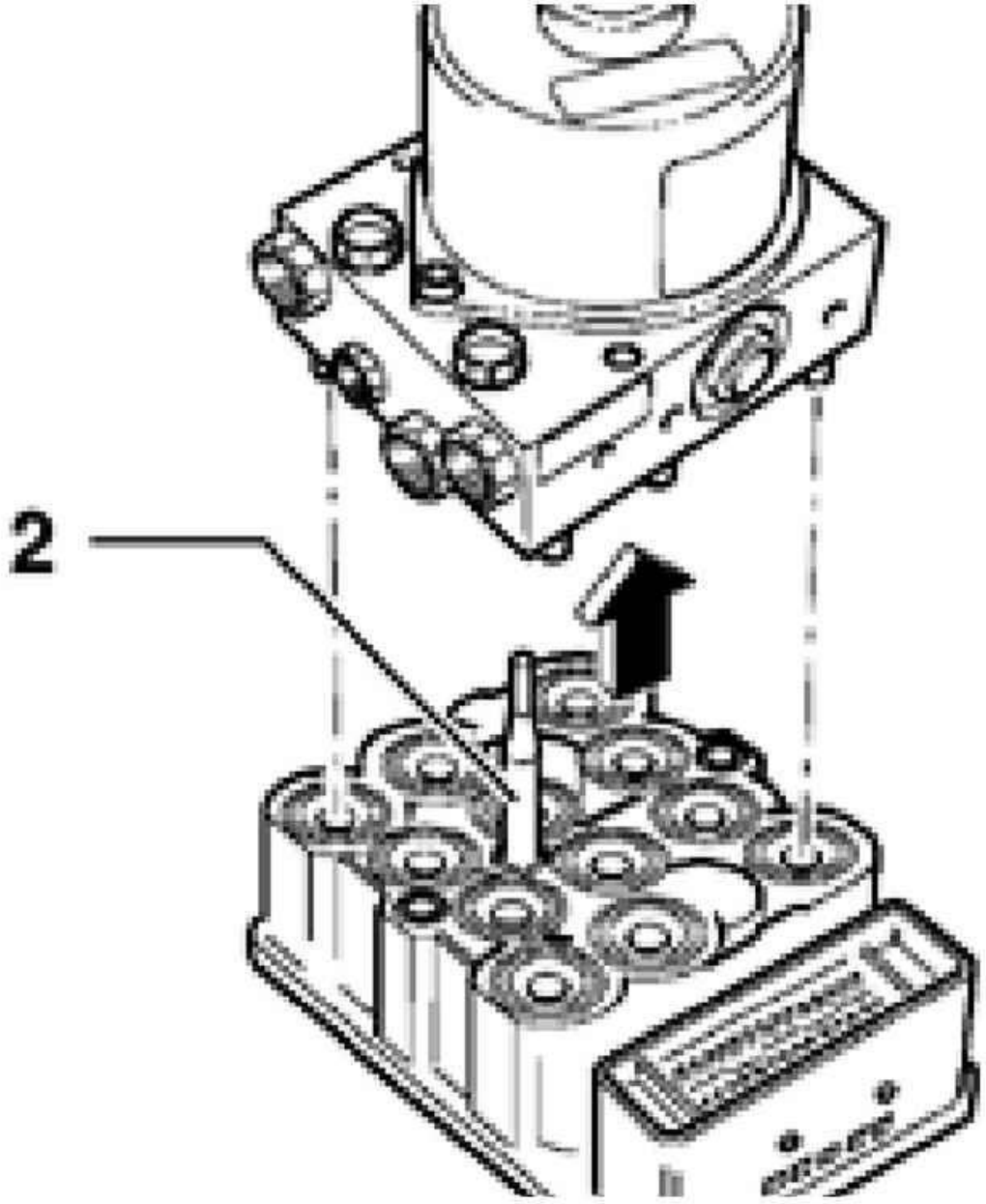

Fig. 184: Scan Tool Display - A/C System Signals (2 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -3- buttons to select Function 03: "Output Diagnostic Test Mode".

Display will appear as shown:

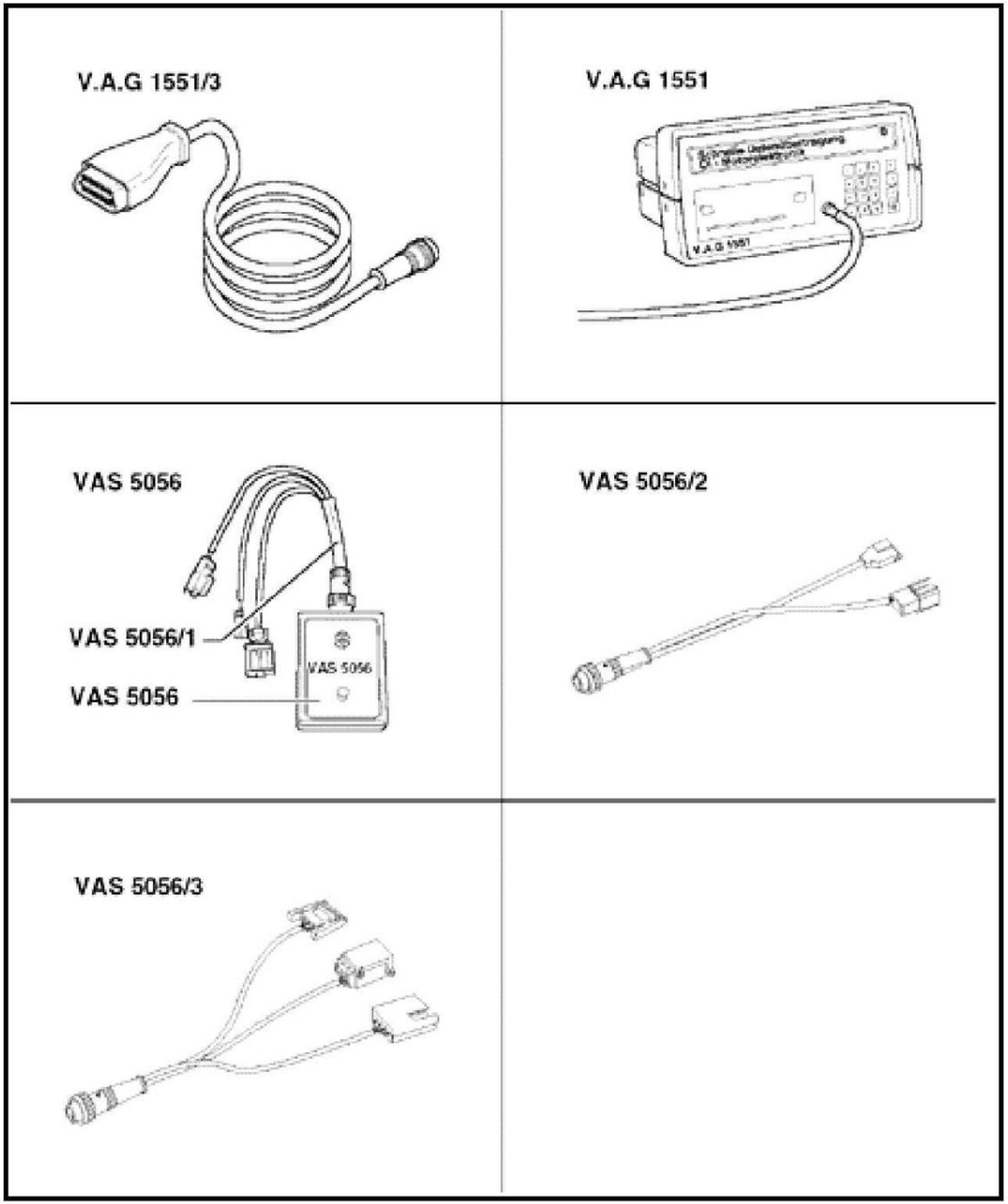

Fig. 185: Scan Tool Display - A/C System Signals (3 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -Q- button to enter input.

Display will appear as shown:

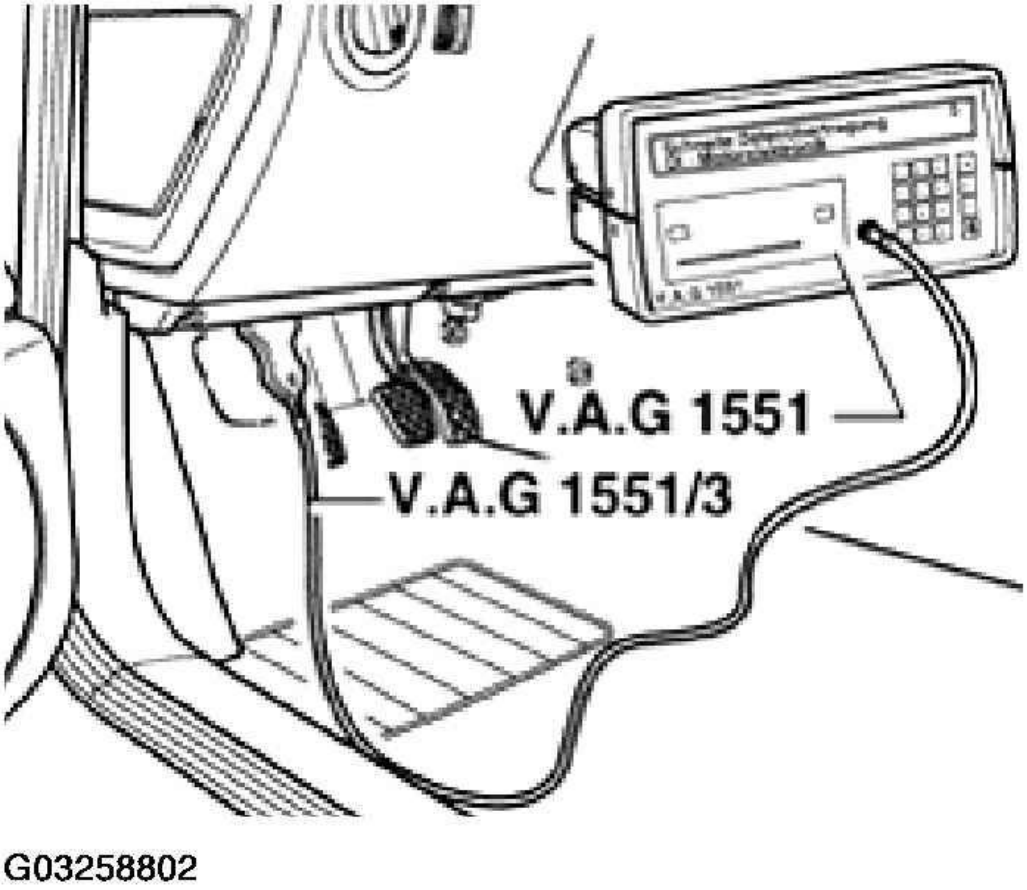

Fig. 186: Scan Tool Display - A/C System Signals (4 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press --> button.

Display will appear as shown:

Fig. 187: Scan Tool Display - A/C System Signals (5 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press --> button.

Display will appear as shown:

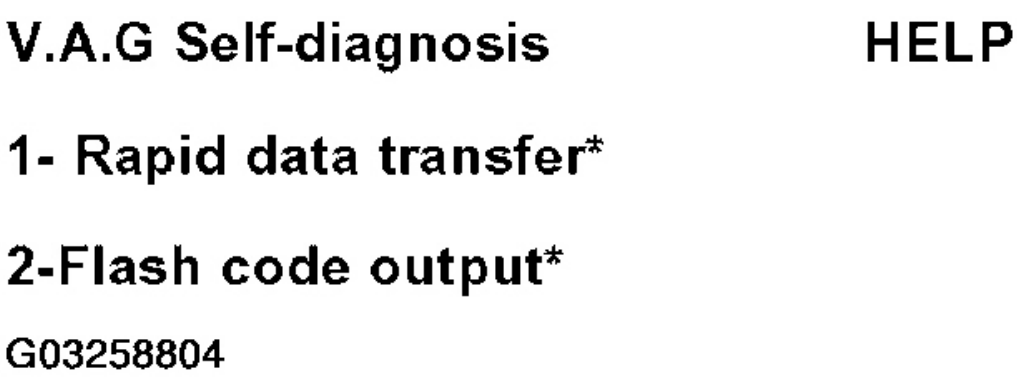

Fig. 188: Scan Tool Display - A/C System Signals (6 Of 6)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- A/C compressor shut-off is checked via Output DTM.
- The A/C compressor must stop within 5 secs, (visual check) then start approx. every 5 secs. and then stop.

If A/C compressor NOT switched OFF

- Proceed with Function 03: Output DTM, until completed.
- Press -0- and -6- buttons to select Function 06: "End output".
- Press -Q- button to enter input.

- Connect VAG1598/22 (or 1598/31) Test Box to ECM wiring harness

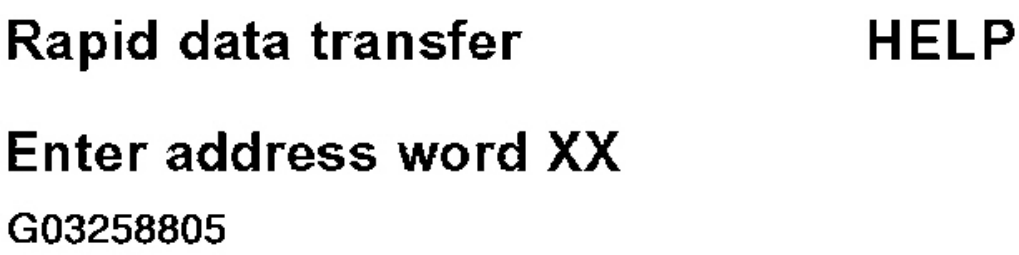

Fig. 189: Connecting VAG1598/22 (Or 1598/31) Test Box To ECM Wiring Harness
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check wiring for open circuit between following Test Box socket and A/C system using Electrical Wiring Diagram.

See appropriate System Wiring Diagram article.

Up to MY 1999

Socket 16

From MY 2000

Socket 29

- Wire resistance: 1.5 ohm maximum

A/C system signal to ECM (engine speed adaptation), checking

The A/C system signal make sure that the Engine Control Module maintains A/C system operation constant regardless of load at idle.

Test sequence

- Connect VAG1551/1552 Scan Tool. See **VAG1551/1552 SCAN TOOL, CONNECTING** .
- Start engine and let idle.
- Press -0- and -1- buttons to select Address word 01: "Engine electronics"

Display will appear as shown (example only):

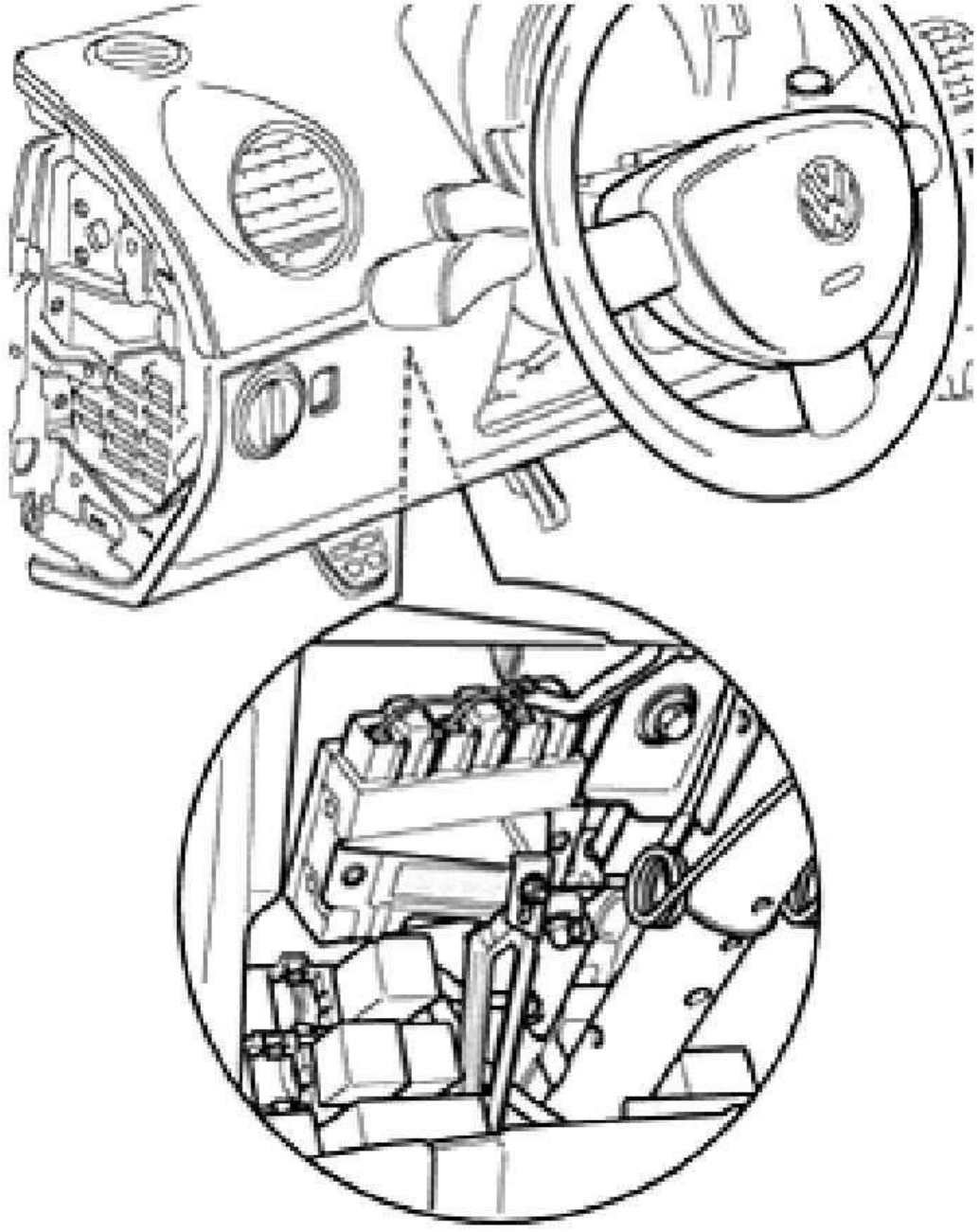

Fig. 190: Scan Tool Display - A/C System Signal To ECM (1 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press --> button.

Display will appear as shown:

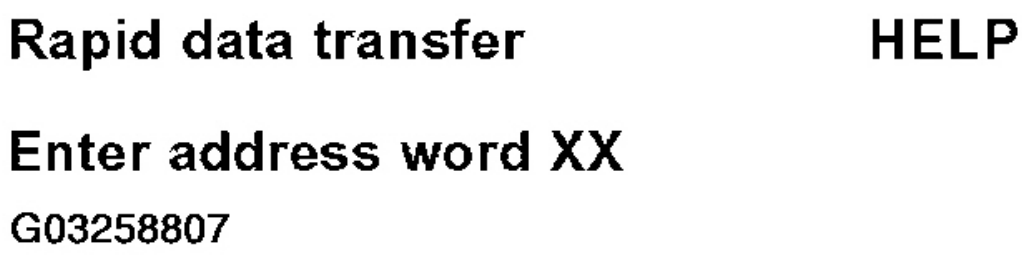

Fig. 191: Scan Tool Display - A/C System Signal To ECM (2 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0- and -8- buttons to select Function 08: "Read measuring value block".
- Press -Q- button to enter input.

Display will appear as shown:

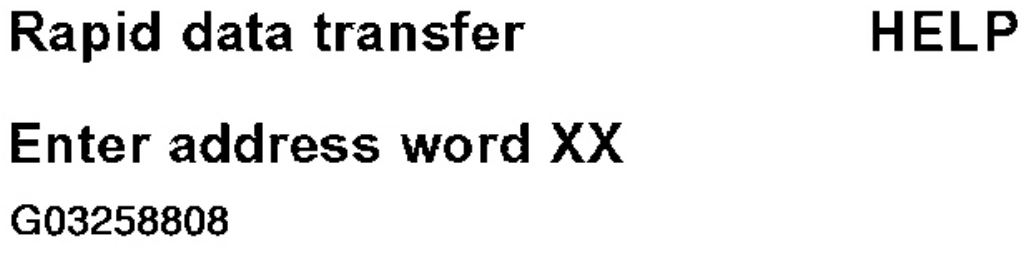

Fig. 192: Scan Tool Display - A/C System Signal To ECM (3 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press -0-, -0- and -2- buttons to select "Display group 2".
- Press -Q- button to enter input.

Display will appear as shown (1 to 4 = Display zones):

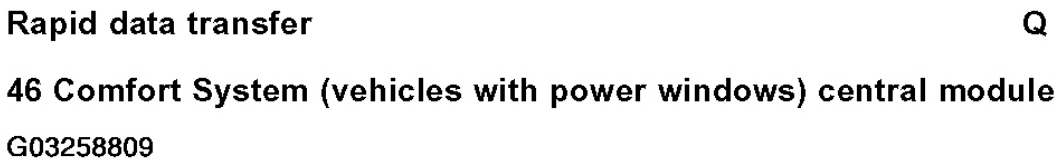

Fig. 193: Scan Tool Display - A/C System Signal To ECM (4 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Switch ON A/C by pressing "Auto" button and selecting lowest temperature.
  - A/C compressor must run.
- Observe display in Display zone 3.

If specification not obtained:

- Specified Value: 1 X 1 (A/C system signal)

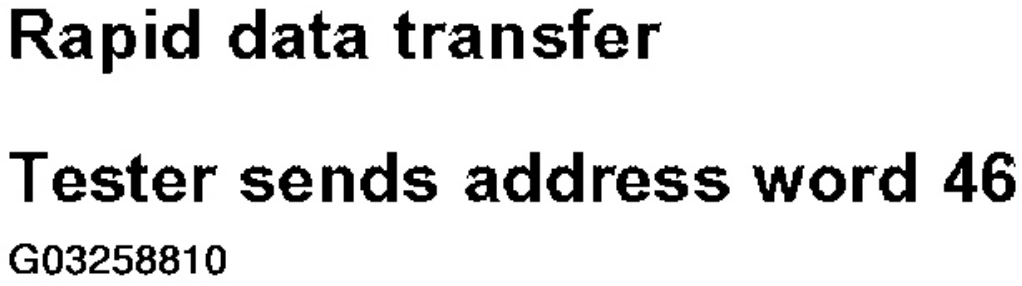

Fig. 194: Scan Tool Display - A/C System Signal To ECM (5 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Connect VAG1598/22 (or 1598/31) Test Box to ECM wiring harness.

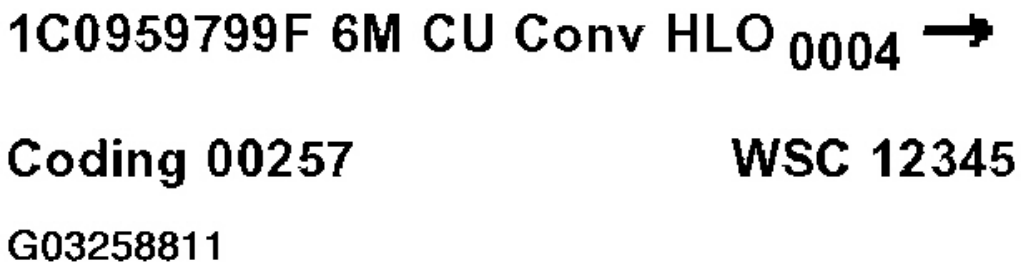

Fig. 195: Connecting VAG1598/22 (Or 1598/31) Test Box To ECM Wiring Harness
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check wiring for open circuit between following Test Box socket and A/C system using Wiring diagram.

Up to MY 1999

Socket 48

From MY 2000

Socket 34

- Wire resistance: 1.5 ohm maximum

CAN-Bus, checking

NOTE: The following list refers to Fig. 196 .

1. **Engine Control Module (ECM)**
2. **ABS control module**
3. **Transmission Control Module (TCM)**
   - Only vehicles with automatic transmission
4. **Airbag control module**
5. **Instrument cluster**
6. **CAN-Bus**

Please wait

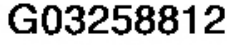

Fig. 196: Identifying CAN-Bus Components
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Function

The Engine Control Module (ECM) (item -1-) communicates with the ABS control module (item -2-), the Transmission Control Module (item -3-), the airbag control module (item -4-) and the instrument cluster (item -5-) via a CAN-Bus (item -6-).

Function, continued

At least two control modules capable of CAN - Bus are connected by two wires (CAN-High and CAN-Low, twisted together) and exchange information (messages). Missing information on the CAN-Bus will be recognized as a malfunction by the ECM as well as by other CAN-Bus control modules.

All control modules have 120 W terminal resistors which make sure that the CAN-Bus can function without fault.

Special tools and equipment

- Multimeter (Fluke 83 or equivalent)
- VW 1594 adapter set
- Wiring diagram
- VAG1598/21 Test box

Test conditions

- Malfunction has been recognized by CAN-Bus OBD
- ABS control module coded to CAN-Bus operation

Test sequence

- Connect VAG1598/21 test box -1- to ABS control module wiring harness -2-.

Fig. 197: Connecting VAG1598/21 Test Box To ABS Control Module Wiring Harness
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check terminal resistor in Engine Control Module (ECM) by performing resistance measurement between test box sockets 10 + 11.
- Specified value: 115 to 135 W

If the resistance value is outside the specified range:

- Replace Engine Control Module (ECM). See **Engine Control Module (ECM), replacing** .

If the resistance value is within the specified range:

- Check CAN-Bus wiring using wiring diagram.